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A JOURNEY AROUND THE WORLD.
II.

By J. C. Willis.

While in England for a little over three months, we were mainly occupied in visiting relatives; and attended the Darwin Centenary at Cambridge, where we represented Peradeniya. We sailed for New York on September 25, and went straight to Boston, where we represented Cambridge (England) at the inauguration of President A. L. Lowell as President of Harvard University, Cambridge, Mass. After these great functions were over, we gave a course of lectures upon Agriculture in the Tropics to an audience of about 60, including several ladies. The general line taken was an amplification of the latter half of our book on this subject, especially insisting upon the cardinal necessity of arranging questions of land, capital, transport, etc., before real agricultural progress can begin.

Considerable interest is taken in such subjects in America, which struck us as a country ready to admit that she did not know very much about tropical colonisation, and anxious to learn all that could be learnt, with a view to doing the best possible for the Philippines, etc., where she admitted that many mistakes must be in process of making. Even in the women's colleges instruction in economic botany, &c., was in progress, and we gave a lecture at Bryn Mawr College, by request, to a class of nearly one hundred students, on the Economic Geography of tropical Asia, pointing out how the agricultural industries were determined by the geographical distribution of the plants, the climate, transport, and labour facilities,

In Philadelphia we read a paper on the Botany of Ceylon to a large audience at the American Society of Natural History, the oldest scientific society in America, and had a good discussion afterwards. We spent some time in the great Commercial Museum in this city, which is in many ways the finest of its kind in the world; and some features of which, notably the public lectures, and the aid given to schools by lending them small collections with books of information, diagrams, etc., are well worthy of imitation locally.

In New York the most striking change since last we were there is in the height of the buildings, two of which now reach 610 and 720 feet. Being built of steel and concrete these buildings are quiet, clean, and safe, and the system of construction might very well come in in Colombo, where the light is as good as in New York. In London, on the other hand, it would be perfectly dark in a street with such lofty buildings.

The newer buildings are very handsome, and it must be admitted that a new school of architecture is developing. The Botanic Gardens in New York are still in process of being laid out, but are rapidly coming into good condition, and will soon be among the finest on the globe.

In Washington we spent most of our time in the Department of Agriculture which is now partly housed in magnificent quarters upon the Mall. We gave a lecture upon scientific progress in tropical agriculture to the assembled department, especially dwelling upon school gardens, in which great interest is taken in America. We saw mangoes being grafted upon a large scale in the green-houses, and the mangosteen being freely grafted (for sale) upon the Cochin goraka (*Garcinia Xanthochymus*), besides many other interesting things. We also interviewed Mr. Austin, chief of the Department of Commerce, and considered with him the influence of transport facilities and other things upon agriculture.

Arrangements were made for exchange of a number of fruit and other plants between Ceylon and America. Among other interesting work lately done by the department there is the production of a frost-resisting orange, which will open up a good deal of country hitherto useless for the purpose, to this cultivation. The success of the date and fig in California is now assured, and one rarely sees in the States any but local fruit of these kinds.

From Washington we went without stop to New Orleans, where one is in a damp, subtropical climate. Here in the Gardens one might see many of the familiar Ceylon flowers growing, such as Cannas, Bougainvilleas, Poinsettias, etc. The French market in the Creole town was interesting, and much resembled the Kandy market. In the country round were large fields of rice, sugar, and other tropical crops. Rice is a great success in the Southern States, and the cultivation is continually extending; it is produced more cheaply than it is here, by virtue of white labour and good machinery.

Passing through the desert of Arizona and New Mexico, where there are little irrigated patches, we came to Southern California, and spent some time there. This we regard as the ideal climate for a tropical resident to retire to. In the warmest weather it is as warm as Nawalapitiya, in the coldest rather colder than Nuwara Eliya. The country itself is like Italy, with lovely blue sea, and snow mountains behind, to which one can always retreat by the cog-wheel railways if one wishes for cold. The show of flowers of every kind, tropical as well as temperate, is the finest we have seen in the world, and the good suburban streets of Los Angeles, Pasadena, or Santa Barbara are a revelation.

We went on to San Francisco, and spent a week there, and then to Stanford University, a few miles south. We then took the beautiful journey through the mountains to Portland and Seattle, and settled down with relatives in Puget Sound for some weeks. This country is rapidly filling up, and will evidently one day be one of the great centres of population of the world. Seattle now has over 375,000 people, Tacoma 150,000, Vancouver 100,000. It would lead too far outside the scope of an agricultural journal to discuss this district. We went into several agricultural questions there, however.

Crossing by the Canadian Pacific boat from Vancouver, we had a little time in Japan, but it was under snow, and little of agricultural interest could be seen other than the little fields of tea between Tokyo and Kyoto. On the voyage to Colombo we were prevented from visiting the Malay States by the breakdown of the railway by floods.

GUMS; RESINS, SAPS AND EXUDATIONS.

THE SCIENCE AND PRACTICE OF PARA RUBBER CULTIVATION.

By John Parkin, M.A., F.L.S.

(From *Science Progress*, No. 15, January, 1910.)

Part I.

Caoutchouc,* the elastic gum prepared by the Indians of Tropical America from the milky juice (latex) of certain trees, became known in Europe during the seventeenth century as a curiosity. It remained so in England till the year 1770, when Priestly recommended its fitness for erasing lead-pencil marks, hence the origin of the name "India-rubber," now often shortened to "rubber."

This substance first assumed commercial importance about the year 1823 through the method of waterproofing patented by Macintosh. Its uses became greatly extended later by the discovery of vulcanisation, a process invented by Goodyear in America in 1839, and independently by Hancock in England about the same period. These pioneers showed that when caoutchouc is intimately mixed with sulphur and subjected to a temperature of about 150°C., its elasticity is not only increased but remains practically uniform through a wide range of temperature; further, its durability is greatly prolonged. Raw caoutchouc, on the other hand, softens with an increase and hardens with a decrease of temperature. Without the discovery of vulcanisation india-rubber would have remained of quite minor importance; very little unvulcanised rubber is now used in manufacture. The demand for raw rubber from this time onwards steadily rose. New uses for it were continually being found, and finally the incoming of the rubber tyre, especially the pneumatic variety, has caused an ever-growing demand.

The great basin of the Amazon has always supplied the largest quantity, as well as the finest quality, of this now indispensable raw material. This caoutchouc, known in commerce as "Para," after the Amazon port of that name, has been the recognised standard for fully half a century. It is obtained from the euphorbiaceous tree, *Hevea brasiliensis*, otherwise known as the Para-rubber tree. Though this is the most important rubber tree, yet several other laticiferous plants furnish commercial caoutchouc- notably among these may be mentioned: *Manihot Glaziovii* (Ceara rubber) of Eastern Brazil; *Castilloa elastica*, of Mexico and Central America; *Funtumia elastica* (Lagos rubber), and species of *Landolphia* of tropical Africa; *Ficus elastica* (Rambong) of Assam and Malaya, the familiar "rubber plant" of our greenhouses. At the present time Brazil furnishes about 60 per cent. and Africa 30 per cent. of the world's supply.

The consumption of India rubber has augumented so rapidly within the last few years, owing largely to the great increase in rubber-tyred vehicles of all kinds, that the supplies are becoming quite unequal to the demand. Hitherto the world's crop of rubber has come solely from wild sources. In all probability if the cultivation of caoutchouc-yielding trees had been delayed much longer, a rubber famine would be imminent. As it is, there will be a shortage in supplies for a few years to come. Prices for the raw material will rule high, and rubber goods will tend to become dearer or of lower quality through admixtures. The extended use of caoutchouc will be prevented, and its much-needed employment for flooring and pavement, where wear and tear is great or silence desired, will have to be postponed. The manufacturers are now paying an unprecedented and quite unforeseen price for this raw material. Fine hard Para is at present quoted in the London market at about 7s. d. per lb. * A year ago it was only 5s.; in fact it is now nearly double the average figures for the twenty-five years preceding 1909. In July, 1909, the price rose sensationally from 6s. to 8s. per lb. It was generally expected that it would drop considerably in the autumn with the incoming of the Amazon supplies. These, however, turned out to be smaller than anticipated, and instead of a fall, a rise of another shilling per lb. took place.† At present there seems to be a probability of a 7s. basis instead of a 5s. one being maintained for some time. The sooner the price can be brought down to 4s. or 5s. per lb. the better for the progress of the world generally.

* The word "caoutchouc" is a corruption of the native name for this substance.

* London price 7s. 6½d., December 24, 1909.

† The record figure, 9s. 2½d. was reached in early November, 1909.

Let us glance at the possible future supplies of wild rubber. Tropical Africa in recent years has supplied a considerable quantity of low-grade rubber, largely owing to the drastic measures ruling in the Congo State. The supplies from this source appear to be on the decline. The ruthless destruction of the Landolphia vines will prevent these plants from furnishing much rubber for some years to come. "Red" rubber ere long will be a horror of the past, and the incoming of the plantation variety will hasten its extinction. The exploiting of fresh areas of Funtumia, and possibly of Landolphia, may make up temporarily to some extent, but the amount of African wild rubber is not likely to increase but rather to diminish,

The only source of real importance is the Amazon region. Statements have been made to the effect that the supply there is well-nigh inexhaustible. Doubtless untapped areas exist, and, further the Hevea tree quickly regenerates itself naturally from seed. Yet under existing circumstances the output from the Amazons does not seem capable of much expansion. The Brazilian Government, however, appears at last to be arousing itself, now that it sees a formidable rival in the plantation rubber of the East. A Congress is shortly to be held at Manaos, the great rubber port of the Upper Amazon, to debate such questions as the extent of rubber lands in unexploited Brazilian territory, and whether cultivation offers the best means of maintaining the preponderance of Amazon rubber in the markets. But Ceylon and Malaya have several years' start in the way of cultivation. Caoutchouc can there be turned out at the cost of only 1*s.* to 1*s.* 6*d.* per lb,, whereas it is calculated that a pound of wild Para rubber costs 2*s.* 6*d.* to collect, a sum more likely to increase than decrease when less accessible regions are approached. The lot of the native rubber-collector is not an enviable one. Unless he can exchange his hard-gotten commodity to some considerable advantage to himself, he is not likely to be induced to exploit less inviting districts. Further, the supply of labour itself for the industry is by no means large. Still there is little doubt that Brazil could considerably increase its production by opening up its remoter rubber lands, by granting increased facilities to the collectors, and by reducing the tax on this export, which is one of the main productions of the country at the present time. This policy would undoubtedly pay with price of rubber at anything like the present figure. But as far as one can foresee, the more distant future of Brazi as a great rubber-producer must lie largely in its adoption of cultivation.

At present plantation rubber forms a mere fraction of the world's supply—perhaps 5 per cent. Since 1905, when about 200 tons, of it were exported from the East, the output has doubled year by year. If this continues the yield in four years' time will be equal to the total annual output of wild rubber at the present time, viz., 70,000 tons. Such a quick rate of increase may not be maintained. Half a million acres, however, will be in bearing in 1914, and, even allowing only a crop of 100 lb. per acre, a low estimate, this would mean an output of 22,000 tons—a considerable part of the world's present supply. In ten years' time the amount of plantation rubber, on a conservative basis, can hardly be less than 100,000 tons per annum. At this period probably supply may begin to overtake demand, with an inevitable drop in prices. Rubber might then descend to 3s. per lb., a price, judging from present conditions, quite remunerative to the planters, but not to the collectors of the wild product. Thus it seems that the world's supply sooner or later will be derived from plantation sources. The possibility of a synthetic commercial caoutchouc appears as far off as ever, and no adequate substitute seems forthcoming. Rubber, then, like the majority of economic plant-products, will in all probability in the near future be obtained largely, if not solely, from cultivated sources. The study, therefore, of the cultivation of rubber trees is of great importance. The methods in use at present for extracting the latex and preparing the rubber therefrom, though fairly satisfactory, cannot be regarded as final. Everything connected with this novel form of cultivation is still in the experimental stage, requiring not only the close attention of the practical agriculturist, but also the services of the botanist, chemist, and physicist, and especially of that much-needed but rare expert, the biochemist.

It is the purpose of this article to describe briefly the methods employed on the estates, and to dwell somewhat on the problems connected with them, hoping thereby to arouse a general scientific interest in the subject. Before doing so, a short account of the history of rubber cultivation may not be out of place.

HISTORICAL.

Although the modern industry of rubber-planting may be considered to date back only some ten or eleven years, yet

to trace this new cultivation from its inception we must revert to the year 1876. The seeds destined to become the source of most of the Para-rubber trees now growing in the East were in that year collected in Brazil, brought to England, and sown at Kew. The young plants raised from these seeds were transhipped to Ceylon. This introduction of *Hevea brasiliensis* to the eastern tropics was due chiefly to the energy and foresight of two men, both happily with us at the present day, Sir Joseph Hooker, then Director of Kew, and Mr. Wickham, at that time engaged in planting pursuits in tropical South America. Drawings of the foliage and fruit of the tree made by Wickham were seen by Hooker, and the latter did not rest until he had pursuaded the Indian Office to grant Wickham a commission for the collection and conveyance of the seed to England. How this was successfully accomplished has recently been retold by Mr. Wickham himself.* The story forms the romance of tropical agriculture. Owing to the short vitality possessed by this oily seed,† no time had to be lost in conveying the quantity collected across the ocean. Some seventy thousand seeds reached Kew Gardens, and from them quickly sprang a good array of seedlings. Ceylon was chosen for their reception, and two thousand young plants reached this favoured isle in 1876. They were mainly planted in a special plot of ground at Henaratgoda in the low country. Soon a small forest of young Heveas grew up. This grove is now historic, for from it the first planters to take up rubber cultivation obtained their seed; in addition these trees afforded the means for carrying out the early work in tapping and the preparation of rubber, upon the results of which the estates have largely based the methods now in use. The total cost of the introduction of the Para rubber tree to the East amounted to £1,500, a trifling sum considering the wealth it is now producing and is likely to produce in the near future.

About the same period Cross was instrumental in bringing to the East two other important caoutchouc-yielding trees of the New World—viz., *Manihot Glaziovii* (Ceara rubber) and *Castilloa elastica* (Central American rubber).

* H. A. Wickham, *Para Indian Rubber* (1908). London, 1908, pp. 45-59 (See review in *Science Progress*, 1909, 3,705-6).

† By careful packing in powdered charcoal the vitality of the seed can be somewhat prolonged.

After the collapse of the coffee industry in Ceylon, the planters for a short time in the early eighties turned their attention to the Ceara rubber tree. However, its cultivation never attained great dimensions, and was soon extinguished by the rush into tea planting. The general consensus of opinion was that Ceara rubber paid to collect, but not to grow.

Castilloa has never been largely planted in Ceylon or elsewhere in the East. It does not grow in the same vigour as Hevea, nor has it taken so kindly to its new home. It is fortunate that Ceylon planters adopted Hevea rather than Castilloa, as all recent returns have shown the former to be far and away the better yielding tree, even though at one period results seemed in favour of the latter. Castilloa, however, has been largely planted in Mexico—in fact, its cultivation commenced there a year or two in advance of that of Hevea in the East. Little, however, is heard at present of plantation Castilloa rubber on the London market. This is partly due to the fact that the trees do not come into bearing as soon as those of Hevea and yield less when they do; and partly because the United States mainly receive what rubber is produced by the Mexican plantations.

In 1888 the late Dr. Trimen, then Director of the Ceylon Botanic Gardens, commenced tapping experiments on the Hevea trees at Henaratgoda, grown from the Kew seedlings. He strongly advocated rubber planting, and was supported by Mr. John Ferguson, editor of the *Ceylon Observer*, who influenced planters, especially in the Malay States, by the publication of a manual on the subject. Dr. Willis, who succeeded Trimen as Director in 1896, took up the subject of india-rubber energetically and enthusiastically. In a circular* published in January, 1898, he advocated the cultivation of the Para-rubber tree as deserving the attention of the Ceylon planters. He induced the Government to sanction the appointment of a scientific assistant. With this help a year's work devoted to rubber tapping and preparation placed Hevea in a still more favourable position as a yielder of caoutchouc. The discovery of the so-called "wound-response" and the elaboration of a ready means of preparing clean rubber from the latex afforded the planters a basis for future procedure. The rush into rubber began then, and has continued ever since with increasing

* J. C. Willis, Circ. Roy. Bot. Gardens, Ceylon No. 4, Series I. (1898).

force. The tree has exceeded the most sanguine expectations regarding its producing capacity and vigour of growth. A few fortunate planters who laid down areas with this tree before this period have been the first to reap their reward.

About 750 acres had been planted with Hevea in Ceylon previous to the year 1899. Now at least 180,000 acres are under rubber in the island, either pure or planted amongst tea and cacao. Ceylon, though the pioneer, has had to give place to the Malay States in respect to area and yield. Planters soon saw an excellent opening for Para-rubber cultivation there. The soil and climate have been found especially suitable for the rapid growth of this tree, and the success already achieved is phenomenal. The premier company, Selangor, formed in 1899, paid a dividend of 75 per cent. for 1908 and is calculated to have earned one of 250 per cent. for the year just closed. Such extraordinary profits are of course partly due to the high market price of raw rubber at the present time, but partly also to increased output. No estate, as yet, has reached its full producing capacity.

Over 300,000 acres are now under Para-rubber in the Malay States. Its cultivation has also extended to Java, Sumatra, Borneo, etc. At least 600,000 acres must now be planted with Hevea in the Middle East.

Attention in certain quarters has been redirected to Ceara rubber (*Manihot Glaziovii*).* As this small tree will grow on dry ground where Hevea would not flourish, and as it produces good caoutchouc at an early age, it may perhaps become of some importance as a source of cultivated rubber. It is being planted largely in German East Africa, Nyassaland, and the Zanzibar Protectorate.

Rambong rubber (*Ficus elastica*) has received from the Dutch in Java considerable cultural attention in the past, and where growing now on any estate the trees are a valuable asset, as the rubber when well prepared commands a price only a little lower than fine Para. It is, however, likely to be replaced gradually by Hevea. Its banyan nature is a drawback to easy tapping, and in other respects it is inferior to Hevea.

The only other arborescent form of possible value for cultivation seems to be *Funtumia elastica* of tropical Africa. Attempts to grow it, however, have not met with much success, and Hevea is being introduced into West Africa in its stead.

The Landolphias are unlikely to become a cultivated source of India rubber as they are climbers (lianes) of slow growth.

Experience all points to *Hevea brasiliensis* as the best tree for cultivation. Manihot may take its place in drier tropical regions. Castilloa, Ficus, and possibly Funtumia might be useful as subsidiary sources, and be grown as trees in protective belts on estates.

GENERAL CULTIVATION.

It is not within the scope of this article, nor is it within the writer's province, to deal in a complete manner with the general cultivation of the Para-rubber tree. However, as this is a crop of a special and novel kind, a few remarks respecting its peculiarities and the problems it offers for solution may not be without interest.

Close v. Wide Planting.—Hevea is a forest tree, and its cultivation might therefore be deemed a branch of forestry and so conform to the rules of sylviculture; but timber production is not the aim, hence close planting with the object of producing long straight poles is not necessarily the best means of growing this tree.

As the latex (rubber milk) is obtained from the bark of the trunk, the main purpose to be striven after is the production of as large an area of bark as possible in a given time. Further, since the greatest yield of latex is from the basal part of the trunk, thus making tapping above six feet, as a rule, inadvisable, it would seem expedient to grow the tree so as to throw the main increase of girth into the basal six to ten feet of bole. In sylviculture the great length of unbranched stem is secured at the expense of its thickness. As soon as the maximum height has been reached, thinning is commenced, in order to give room for a greater development of leaf-canopy to hasten the increase in girth. In rubber cultivation, however, thickness rather than height of trunk is desired from the beginning, so the trees must be planted much wider apart than appertains in ordinary forestry, in order to afford room for an early and ample production of foliage.

The first areas laid down with Para rubber were planted with trees ten feet apart, roughly 400 to the acre. It became evident in a few years that the

*Three other species of Manihot (*M. Dichotoma*, *M. heptaphylla* and *M. piauhyensis*) are now attracting attention as rubber plants. It is too early yet to decide as to whether any of them may be superior to *M. Glaziovii* for cultivation.

growth in thickness would be greatly retarded if the trees were allowed to continue so crowded, consequently thinning has had to be practised. Wider planting is now more generally undertaken, and a distance apart of twenty feet (100 trees per acre) is commonly followed. Even at this interval the shoots of adjoining trees will often begin to interlace in five or six years' time, about the period when tapping can be commenced. Judicious thinning might be started now by removing the least desirable trees after thoroughly tapping them.

The correct planting distance to be pursued is still an open question. Time will doubtless show whether room for the ultimate possible extension should be provided at the outset, or whether a closer distance should be adopted while the trees are young, to be followed by thinning later. In the latter case probably more rubber may be obtained per acre during the first couple of years of tapping, but this may be at the expense of future yields. The present view appears to be rather that within reasonable limits a closely planted acre of rubber is worth no more than, if as much as, a widely planted one.

Straight v. Forked Trunks.—Since tapping is usually confined to the basal six feet of trunk, and since trees which fork early have generally a greater basal girth than those of the same age which remain straight, attention has been turned to the desirability of artificially inducing trees to fork early, in order to hasten their increase in girth. This can be accomplished with the least injury and trouble by what is known as "thumb-nail" pruning. The terminal bud is pinched out when the young tree has reached a height of about ten feet; forking then takes place, and further pruning can be practised if necessary to reduce the number of main branches. Wickham strongly recommends this practice and considers the ideal tree-form for Hevea to be three main primary limbs, and to each of these three secondary branches—nine in all. Wright* also favours it, though pointing out that it is unwise to practice it on trees growing in a light soil and exposed situation, for they would in time be liable to be blown over by strong winds, owing to the weight of leaf canopy produced; they would, in fact, be more top-heavy than unforked trees.

Petch,† Mycologist to the Ceylon Government, fears that such treatment will favour the entrance of the fungus *Corticium javanicum*, a somewhat dreaded bark disease. Ryckmann states that in Java and Sumatra this fungus attacks chiefly the forked trees, either natural or induced. The cleft affords a lodging-place for spores. A split in the wood is liable to occur here through wind or other causes, thus allowing the entrance of the fungus-hyphæ, and so the commencement of disease.

Catch Crops.—As a newly-planted area of Para-rubber will give no return for at least five or six years, and as between the widely planted trees there is much unoccupied ground, some profit may be immediately secured by growing what are called catch crops. Though their cultivation may lead to the payment of small dividends before the rubber comes into bearing, their value is to some extent doubtful, as these interplanted crops frequently retard the growth of the rubber trees. Cassava (*Manihot utilissima*) has been largely used, but it is hardly a desirable plant to employ, as botanically it is too nearly related to Hevea. A disease or insect enemy which attacks the one will most likely spread to the other. The subject of catch crops and their undesirability is dealt with fully in Wright's book.‡ There is much to be said for and against their cultivation.

Protective Belts.—A large uninterrupted area occupied by a single species of plant offers a most suitable field for the spread of a fungus or an insect foe. There is nothing to check a disease commencing at one point from spreading rapidly over the whole plantation. Consequently a system of blocks, separated from one another by screens composed of other trees, is recommended for rubber estates. A disease or pest observed in one block might then be overcome before it had time to penetrate to a neighbouring area.

These protective belts may be formed by the retention of strips of the virgin forest, or they may be planted specially. If the latter course be adopted, trees of economic importance should, if possible, be chosen, care being taken not to select any nearly related to that composing the main cultivation. For example, Castilloa or Ficus might be used in connection with Hevea, thus affording

* H. Wright, *Hevea brasiliensis* or *Para rubber*, 3rd edition, 1908, 48-51.

† Petch, *Circular and Agricultural Journal*, Royal Botanic Gardens, Ceylon, 1909, No. 21, Vol. iv., p. 193.

‡ H. Wright, *Hevea brasiliensis* or *Para rubber*, 3rd edition, 1908, 51-6. (The Standard work on rubber cultivation.)

extra quantities of caoutchouc; or trees useful for supplying timber for the estate might be planted. Manihot would not be advisable, as it not only belongs to the same family, the Euphorbiaceæ, but also to the same tribe. Fungi and insects often confine themselves to nearly related groups of species.

Seed-Selection.—Another matter worthy of brief mention is seed-selection. Too little attention has hitherto been paid to this. Estates, as a rule, have been planted with seeds from Hevea trees irrespective of their rubber-producing qualities. Selection might have been commenced ten years ago to the great advantage of those now about to engage in Para-rubber planting. It is not too late to begin, since even if the laying down of new areas in rubber should soon cease, old estates will doubtless require some renewing in course of time.

Suggestions* thrown out about the advisability of selection nine years ago were not heeded. In the interval nothing systematic in this direction has apparently been done. Now several are beginning to see the importance of turning attention to seed-selection. Sandemann† has recently advocated the practice strongly and writes: "The matter was not perhaps so very pressing at the present moment, but would prove to be of very great importance if the price of rubber fell considerably, and especially so if that of labour rose coincidently."

Apparently there is a strain of Hevea now growing in the East which is a poor latex yielder but a great seed bearer. If care be not taken, estates may be planted with this variety, only to cause grave disappointment in a few years' time, when the trees reach the bearing age.

Now that plant-breeding has almost become an exact science, largely through the application of the principles of Mendelism, comparatively quick results might be obtained even with a tropical tree. In ten to fifteen years' time seeds of a valuable strain might be forthcoming with which estates could replace worn-out trees or plant additional ground. The writer has referred in greater detail to this matter in a recent article.

(*To be continued.*)

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* J. H. Hart, *India Rubber World*, October, 1900, p. 6; J. Parkin, *idem*, January, 1901, p. 105.

† Sandemann, *India Rubber Journal*, 1909, vol. xxxviii, p. 345.

TAPPING CEARA RUBBER IN MYSORE.

(From the *Planters' Chronicle*, Vol. V., No. 7, March, 1910.)

(*Altitude of Plantation*—about 3,300 feet.

Average Rainfall—90 to 100 inches; chiefly from June to October; occasional showers in April and May, but frequently no rain from October 1st until April following).

Example I.—Ten of the best grown trees in a 5-acre clearing, 3½ years old and averaging a girth of 13 inches, three feet from the ground, were tapped on alternate days during October and December, 1909, and February, 1910, *i.e.*, 440 tappings. The aggregate yield of latex was 6,372·25 c.c. (1,795 drachms) which resulted in 4½ lbs. dry rubber.

This is equivalent to 90 lbs. dry rubber per acre of 200 trees for six months, or 180 lbs. per annum, tapping on alternate days and alternate months.

Note.—Of the above one tree proved a poor milker, giving slightly less than half the quantity of latex of the other nine.

Example II.—Five trees in a five year old clearing, averaging a girth of 17 inches, tapped as above, yielded 7,188·75 c.c. (2,025 drachms) latex, which gave 5 lbs. dry rubber. Equivalent to 200 lbs. dry rubber for the six months, or 400 lbs. per annum per acre.

Example III.—Five trees, seven years old, girth 26 inches. Tapped as above yielded an aggregate of 12,709·00 c.c. (3,580 drachms) giving 9 lbs. of dry rubber. Equivalent to 720 lbs. of dry rubber per acre per annum.

Example IV.—Two trees, ten years old, with girths of 32 inches, gave respectively 900 and 855 drachms of latex, tapped as above, which gave 2¼ lbs. and 2¼ lbs. dry rubber. Equivalent to 875 lbs. dry rubber per acre per annum.

Example V.—One fifteen years old tree, having a girth of 43 inches, tapped as above yielded 1,575 drachms latex, giving 4 lbs. dry rubber. Equivalent to 1,600 lbs. dry rubber per acre per annum.

The trees appear to have suffered no harm whatever; I intend to tap them again in April, while bare of leaf, and again in June and August, during the S. W. monsoon, and shall be curious to see how the yields compare with those already obtained.

With the cheap and skilful labour in Mysore, it should be possible to place Ceara rubber on the market at consider-

ably less than can be done from the Straits or Ceylon; however, even taking the cost of cultivation, tapping, etc., at one shilling and rubber at four shillings per lb. Example II. points to a nett profit of over £50 an acre at five years old. (£100 with rubber at its present price.) I hope some of your readers in Coorg, where I believe Ceara has been extensively planted of late, will forward some of their results; in any case I am perfectly satisfied in my own mind that Ceara, if taken up seriously, can and will do for Mysore what Para has done for the Straits Settlements.

CAOUTCHOUC AND ITS COLLECTION IN THE UPPER AMAZON REGION.

(By O. Sperber, *Tropenpfl.*, February, 1910. Abstracted by J. C. Willis.)

These districts, which belong to Peru, turn out to be richer in rubber than was anticipated.

At present the collectors only tap the following species:—

	Feet high.	Diameter.
Hevea guayanensis, ...	50-65 ...	2′6″-3′6″
,, brasiliensis ...	55-65 ...	2′6″-3′6″
,, andimensis ...	50-65 ...	3′0″-3′6″
,, lutea ...	55-65 ...	2′ -2′6″
Castilloa elastica ...	50-65 ...	2′ -2′6″

There are, however, several other Euphorbiaceæ that will yield rubber, and which will doubtless be tapped sooner or later.

As the worker has to travel even for months by boat, the stretches between the rivers have as yet been but little exploited.

The workers seek new districts in July, August and September, when the rubber trees bear the differently coloured young leaves.

Tapping begins in October and lasts till December. During the next three months the rain makes the trees unapproachable, and they are again tapped in April, May and June. The average yield of a tree is 5 kg. (11 lbs.) of first-class rubber.

Official statistics of export give

	lb. value	Mk.
1904 ...	4,814,055 ...	13,250,264
1905 ...	5,484,371 ...	18,370,465
1906 ...	5,531,171 ...	14,668,350
1907 ...	6,661,435 ...	19,091,459

CLEAN WEEDING V. TEPHROSIA.

(From the *Agricultural Bulletin*, Straits and F.M.S., Vol. VIII., No. 4, April, 1908, p. 131.)

For a long time scientists have called attention to the disadvantage of weeding and have advised the introduction of new methods; but their ideas have not been well received, and so far little has been done on practical lines.

Interest has however been awakened, experiments with leguminous and other plants are common, and I hope to be able to show that one plant may be used with both economical and other advantages.

In this article it is not proposed to go into the theoretical side of the matter. What at present appeals most to people is the cash expenditure for keeping weeds down—or out, the cheapest way being naturally the most popular one, and weeding will here only be dealt with from this point of view.

Of course with virgin jungle properly dealt with from the start, the weeding bill should never look high, and old established estates will perhaps naturally adhere to their old method.

Most plantations have however in one corner or another a block of old abandoned paddy-fields or Malay kampongs, and in such places a cheap method of getting rid of weeds is much wanted.

I, at any rate to get, have had the bad luck of getting a few acres of such land indifferently burnt, and all the planters who have seen it have invariably advised me to changkol the whole place at a cost of anything between $20 and $60 an acre.

For various reasons this work was not done, but I believe most planters will from experience be able to state, if the above price is correct.

For some time experiments have had been carried on with a view to introduce a plant, which would be able to keep weeds out, and at the same time itself benefit or at least do no harm to the rubber trees, and for this purpose I have found *Tephrosia purpurea* admirably adapted.

As this plant, seed of which was kindly presented me by Dr. Treub of Buitenzorg, is new to the F. M. S., some information of how it was established may be of interest.

The first plot was only 20′ by 40′ and was planted up with one or two seeds in every square foot. The place was then clean of weeds but had not been chang-

kolled, and some lalang had only been cut down, while the roots were untouched.

In the second plot conditions were different.

In belukar land, to save expense, a path or rentis 6 feet wide had been cut along each row of trees, and when at this work the coolies had generally scraped aside a little earth by which gradually two ridges had been formed one on each side of the row of trees. In these ridges every few feet a couple of seeds were put in, and after 5-7 weeks all failures were supplied. Otherwise no special care was taken, only of course the coolies were told not to pull these plants up when weeding, and care should be taken to choose a rainy season for this work.

The *Tephrosia* will grow slowly at first, and at four months old it has only grown into a small bushy plant, but it then commences to assert itself amongst the surrounding weeds. When full grown it is about 5-6 feet high, and each plant spreads to the same extent.

My oldest plot was sown in June, and has not been weeded since the end of August, 1907, viz., during 19 months.

One cieeper has grown up in it, but in other ways it looks all right, and the lalang, which formerly was on this spot, has now disappeared.

My second plot was planted May last partly in lalang. The *Tephrosia* now form two solid hedges through which nothing penetrates, and the weeding is here done at a very small cost.

The hedges are sufficiently apart to allow the air to circulate along the trees, and the ground is always soft and nice. So far the time has been too short to show any advantage in growth of trees, but they certainly look as good as any in my clean weeded area.

To make the *Tephrosia* grow in hedges has the advantage of a better air-circulation around the roots, and it also makes it easier to get about when inspecting the plantation; but other methods have also advantages. To take an example, where trees are circled, it would be very easy to put in a few seeds around each tree.

The *Tephrosia* grows rather high, and ought on this account to be cut down once or twice a year, but in other respects this height gives the plant a great advantage, when fighting lalang and other high weeds. As it is not a creeper it may safely be planted together with rubber stumps, coffee, etc., without fear of their being interfered with; and as it is a good fertiliser, has few natural enemies, is very hardy and propagates itself when once established, it must be considered an ideal plant for its purpose.

Under the conditions mentioned the planting of *Tephrosia* represents a great and direct saving. Having however reached so far, it might be rather interesting to see, if the step could not be taken in full, and the same plant be introduced with advantage also in clean estates.

The question is what clean weeding costs, and how much money could be saved by planting *Tephrosia.*

The general opinion is that 30 cents an acre a month is a low price for weeding. This is often not sufficient, and also it is only the pay of the coolies and does not include anything for management and other consequent expenses, so that really the expenses are much higher, and a fair idea of what it costs would be obtained by charging all expenses for upkeep of an estate to weeding, as of course little other work remains to be done.

If an estate when first planted up could be left to itself until the trees came into bearing, then the saving ought to be at least $1·50 an acre a month, and in many cases much more, or say as a low figure $20·00 per annum; and it now remains to be seen what it costs to establish *Tephrosia,* and if by this proceeding the above money could be saved.

The first item is easy to settle, I have found $4·00 an acre ample and to spare.

The second point is also easy; experience from abandoned estates and other places show that, if not hampered by lalang or grass, trees will grow as well or better under natural conditions that is in weeds, as in clean land.

When now comparing the merits of the two methods we get:—

TEPHROSIA.

Cost of establishing Tephrosia ...	$4·00
Weeding expenses for 5 years per acre	$100·00

TEPHROSIA.

Cost of establishing Tephrosia ...	$4·00
Keeping drains clean ...	1·00
Land Rent	1·00
Cut down Tephrosia twice ...	2·00
Various	1·00
Supervision	1·00
Total cost 1st Year	$10·00

2nd and following years.

As above less $4·00 for establishing Tephrosia	$6·00
Total expenses for 5 years ...	$34·00
Total saving	$66·00

F. ZERNICHOW,
Jendarata Estate,
Teluk Anson.

BRAZILIAN RUBBER INDUSTRY.

(From the *Indian Trade Journal*, Vol. XV., No. 196, December 30, 1909.)

A correspondent writes as follows to the *Times* Financial and Commercial Supplement of December 10th:—In view of the high price of rubber and the activity shown in the floating plantation companies, it is surprising that so little is known concerning the principal rubber field of the world, namely, the Amazon Valley. This ignorance, I think, was clearly illustrated by the comments made in various papers on the report of Mr. Cheetham, Secretary to the British Legation at Rio de Janeiro. When I first went into the Para rubber industry I found it impossible to accept any information respecting the exact facts of working, and other matters, from any one because every one gave a different version, Accordingly I set to work to investigate the matter for myself, and found that there was one essential to be provided; that was not labour, as may be supposed, but working capital.

OWNERSHIP OF LAND.

It may be useful to deal first with the question of title or ownership, this being a point raised by many. The statement that one does not know positively how much land one owns is incorrect. According to Brazilian law as soon as a person has an estate he must know the area to the square metre—the land is measured in metres, and not in acres. Before a purchase is legalized the land must be surveyed (demarcated, it is called) by an authorized surveyor, the plans, etc., deposited with the Government, and the necessary fees paid. Then, and not till then, is a grant of land made. No purchase of property should, of course, be made until the survey has been held and the grant forthcoming, so that with care no one can go very far wrong. In the event of the transfer of a rubber or other estate from an individual to a company it would be necessary for the company to deposit in one of the local banks 10 per cent. in cash of the total registered capital before the transfer could be legalized, and the company placed in a position to carry on the business in its own name. The deposit, of course, could be withdrawn as soon as the transfer was completed.

SYSTEM OF WORKING.

With regard to the system of working, it will be seen from the following remarks how important is the question of an adequate supply of working capital. For instance, a man gathering from 150 to 200 tons of rubber a year, and employing from 500 to 600 workers, whom he would have to supply with food, etc., would have his own boats for the conveyance of rubber down the river to Para or Manaos, and for carrying back food and other merchandise. If the property were on a river navigable during several months of the year he could buy merchandise on better terms. The cost price of goods, duty paid, at Para or Manaos required for 500 men during the year would amount to £20,000 to £25,000. The grower would be charged by the importer or merchant from £28,000 to £36,000, for nearly every grower is more or less in the hands of the merchant, and when the goods were delivered to the chiefs or headmen on the estates the cost would have increased by from 15 to 30 per cent. By the time the goods were distributed by the chiefs or headmen among the labourers another 20 to 30 per cent. would have been added to the cost. From these facts it will be seen why Brazilian rubber is so costly to gather. But there is nothing to prevent any company or individual possessing the necessary capital from avoiding many of the charges which help to swell the cost of production.

The native gatherer from Ceara and Peru earns from £70 to more than £100 per annum, and his annual output is about 800 lb. of rubber on the estates on the lower rivers, and 1,200 lb. on the upper, and especially the Acre River.

INCREASE IN PRODUCING TREES.

With regard to the number of rubber trees maturing yearly there is nothing like the number that there should be. Little care is ever taken to assist the growth of the young trees, and most of them are allowed to smother each other in the jungle. In view of the fact that only the districts bordering on the five rivers in the State of Amazons produce rubber trees, and that the Island of Marago, State of Para. accounts for half of the entire produc-

tion, especially of the first grade, and also that the trees are very scattered further back from the rivers, I fail to see where the new territory exists that remains to be opened up. Unless the price of rubber continues at about the present high figure, the Brazilian output cannot increase greatly until the industry is properly handled.

Need for Organized Exploitation.

Business ability allied with sufficient working capital are the primary needs for the successful exploitation of the rubber resources of Brazil. Given these conditions, a good profit with return of capital might be secured long before the majority of the Eastern plantations reach the producing stage. Moreover, large areas bordering on the navigable rivers contain tens of thousands of young plants waiting to be transplanted into open spaces, and these would ensure a future supply at little cost, as it would mean the opening up of the narrow zig-zag estradas or roads, so that each labourer could gather double the amount he does at present. By growing most of the food required and by keeping live stock, which do well in that part of the country, the cost of maintaining a labourer would not amount to more than £20 or £30 a year, and he would be placed in a far better position than at present. Comparing the area of land which a company could secure with the small estates of the East, which are capitalized at many pounds an acre, a property in Brazil would, I think, require a very much smaller sum. I consider, as a result of practical experience, that much of the Amazon land is as fertile as land in Australia now worth from £6 to £9 an acre.

With regard to the export duty, I admit it is very high. On the other hand, I agree with Mr. Cheetham that it requires little labour or ability to gather rubber, and with the price over 5s. a lb. the duty should not kill the industry. If the property is properly worked, any man can gather half a ton of rubber a year, and his maintenance would not average more than sixpence a lb. on that output. With the exception of the duty there are no other charges, such as ground-rent, so that there are no formidable obstacles of that kind.

OILS AND FATS.

CEYLON CITRONELLA OIL.

(From the *Chemist and Druggist*, Vol. LXXVI., No. 1570, February 10.)

The exports of citronella oil from Ceylon during 1909 showed an increase of 236,119 lb., being 1,512,084 lb., against 1,276,965 lb. in 1908. The leading destinations were: United Kingdom, 780,049 lb.; the United States, 446,874 lb.; Germany 172,302 lb.; Australia, 45,411 lb.; and France, 42,201 lb. The increase last year is probably a record, and is attributed to new producing districts opened up in the South of Ceylon. It should be pointed out in connection with the above statistics that, although this country still figures as the principal consumer of citronella oil, important quantities credited to England are destined for shipment to Germany and the U. S. A. *via* London. The largely increased exports would seem to suggest that, although adulteration is rampant, the oil does not lose any of its popularity. As the adulteration question has become so acute, it is now stated that both consumers and importers are seriously considering the advisability of altering the terms of sale, and selling only pure citronella oil guaranteed to contain a definite amount of geraniol and citronellal. It is well known that the Ceylon oil in drums is always adulterated down to pass Schimmel's test, but it is stated that during the past month or so some Ceylon shipments have proved of a very inferior character, and have failed to pass Schimmel's test, the consequence being that buyers have refused to accept delivery of such tenders, and in other instances heavy allowances have been made. These allowances have, of course, called a protest from Ceylon shippers, while on this side a movement is on foot with a view to place the citronella-oil business on an entirely new basis as regards quality, *i.e.*, in future pure oil will only be accepted against rival contracts. Whether the movement will be successful, it is difficult to say, inasmuch as the shipper is entirely in the hands of the native distiller or dealer.

THE SOY BEAN TRADE.

(From the *Indian Trade Journal*, Vol. XV., No. 191, November 25, 1909.)

In his Report on the Trade and Navigation of the Port of Dairen (Dalny) for 1908, Mr. Acting Vice-Consul E. L. S. Gordon gives the following particulars regarding the Soy bean trade, which is attracting attention in India just now:—Soya beans have been shipped to Europe from Hankow for some years past, and attempts have been made to open up a trade from Newchwang, but these do not appear to have been successful. It is said that the reason for this is that beans brought down by river absorb moisture while on the water, so that in passing through the heat of the Indian Ocean they are apt to ferment. Beans shipped from Dairen, on the other hand, are brought down by railway and are quite dry at the time of export, while great care is taken in repacking them and loading on board ship. Towards the end of 1908 was commenced a trade in beans with the United Kingdom and Europe, which promises to have a great effect on this part of China, and, in view of the great possibilities of this trade, the following, taken from a report which appeared in the local newspapers some little time ago, may prove of interest:—

"The dry season of 1907 caused the bean crop for that year to be only half of the average. In 1908 there was a good harvest, and the high prices ruling during 1907 encouraged farmers to increase the acreage under beans. Thus, while the total production of beans in South Manchuria was 580,000 tons in 1907, in 1908 it came to 830,000 tons. Adding to this 166,000 tons brought down from the northern districts, the total amounts to over 1,000,000 tons, an increase in round figures of 410,000 tons, or at the rate of 70 per cent. Will this increase go on every year?

"First of all, though there has been an increase in planting, there is a limit to its extension. Millet and kaoliang are the most important products to the natives, as they are the ordinary food of both human beings and cattle, while the stalks are used both for fuel and as building material. It has been calculated that of the total area under cultivation, nearly 60 per cent. is under kaoliang, and from 10 to 20 per cent. under other cereals, leaving 20 to 30 per cent. for beans. It is very rare that one finds as much as 40 per cent. of the land planted with beans. Besides, farmers in Manchuria adopt the alternating system, and do not plant the same crop on the same land every year. If kaoliang is planted one year, millet will be planted the next, and will be followed the ensuing year by beans, though of course, this order is not strictly adhered to.

"Secondly, except for a small portion along the Sungari, there is no land available for new cultivation within easy reach of the railway south of Changchun and Nung-an. In the Mukden district especially every available inch is cultivated, so that to speak of an increase in cultivation along the line of the South Manchuria Railway is a mistake.

"In Mongolia, though some distance from the railway, there are some tracts which are being and will be opened up. The estimated area for fresh cultivation in Mongolia is over 500,000 acres in the Hsinan-chin district, 1,650,000 acres in the four districts of Yo-nan-fu, Tsi-nan, Kai-ton and Ankuan, and over 330,000 acres in Takia, altogether some 2,500,000 acres. It is a question whether the products of these districts will be brought into South Manchuria or not. Though this is quite possible, it cannot be stated definitely that these districts come within the sphere of the South Manchuria Railway.

"At present there is a tendency for the products of North Manchuria to be brought down to South Manchuria. For instance, 150,000 tons of the beans brought to the south this year came from the districts of Suan-chen-fu, Petuna and Takia. This was due to the better arrangements for transactions in beans that exist in the south, and to the fact that the principal customers are Japan and South China. Freight rates also contributed, but it is doubtful whether this situation will continue for long. At present there is a new demand for beans in Europe, but it is said that the amount being exported from Vladivostok is greater in quantity than that from Dairen. The present European demand is still fairly small, but when Vladivostok ceases to be a free port, and the line from Vladivostok to Odessa is in a more flourishing condition, many cargoes will be sent by that route, and this will be still more the case when the Chinese Eastern Railway lowers its freight rates. Taking all these circumstances into consideration, in future, beans from North Manchuria will be sent to Harbin, and those from the Suan-chen-fu district will be sent by the Chinese Eastern Railway for export to Europe.

"From the above description can be gathered the reasons for the increase in 1908, and a general idea of the future

prospects of beans. Now let us take into consideration the average annual production of beans in South Manchuria, and in the districts which may be considered as being within the influence of the South Manchuria Railway.

"The total area of cultivated land in South Manchuria may be taken as 10,000,000 acres. This estimate has been obtained from many reliable sources and checked from the amount of production, so that it may be taken as being as near as possible to the correct figure; at the same time, further minute investigation is required. Of the total area, some three-tenths have been planted with beans which would produce altogether in an average year 1,200,000 tons. But of the afore-mentioned 10,000,000 acres, only about 5,835,000 acres are near at hand to the South Manchuria Railwy, and of this, roughly, 1,750,000 acres are under bean cultivation, producing annually some 700,000 tons. Of the remaining 4,145,000 acres under cultivation about 1,250,000 acres are planted with beans, producing annually about 500,000 tons. This product is from districts some distance from the line and from those west of the Liao River, which are included in the total of 10,000,000 acres given above. After the necessities of the various districts have been satisfied, the surplus is available for the export of beans and bean cake.

"New lands available for cultivation, as previously stated, amount in area to 2,500,000 acres, and taking that part of it which would be planted with beans at 758,000 acres, the production would be 300,000 tons. Beans brought to the south are those grown in the Suanchen-fu and Petuna district. The cultivated area in these districts is over 1,150,000 acres, and the production from three-tenths of this would be 133,000 tons. Beans from Takia, which is one of the newly-opened up districts, are sent to Changchun, and it may be reasonable to suppose that they will continue to be sent to that place. But, should the exports to Europe increase, it is possible that they may be sent to Harbin for the reasons mentioned before. It simply depends on the market price and freight rates.

The land in Yo-nan-fu and the three neighbouring districts has not yet been brought under cultivation. If it were, part of it, about 500,000 acres, will be in connection with Changchun, and the beans will be sent there. As regards the remaining part of these districts it is not yet certain whether beans, if grown, will be sent to Changchun or Newchwang, *viâ* Fakumen. It will depend on the varying financial and commercial conditions which may arise in future, and it is difficult to say beforehand how much will go to Newchwang and how much to Changchun.

"From the Petuna and Suan-chen-fu districts some 130,000 tons may be expected, but it is doubtful whether the total produce is sent down to South Manchuria.

"To summarise: besides the beans destined for Newchwang, there can be accumulated along the railway 600,000 tons from South Manchuria, 300,000 tons from the newly cultivated districts and 130,000 tons from the Petuna and Suan-chen-fu districts, a total of 1,030,000 tons. These figures, however, are estimated by allowing rather a large area for the planting of beans and good harvests in ordinary years. Of the total amount some will be consumed in the places where they are produced, and some sent to other districts, so that the quantity of beans sent over the railway will be less than the above estimate. The figures are given merely to present an indication as near as possible of the total production of beans in the railway districts and the neighbouring lands.

"Finally, beans which used to go to Newchwang, apart from those produced within the Newchwang district itself, are gradually being sent to Dairen instead. This tendency will grow in future, but its increase is limited, as the beans produced in the Newchwang district proper will never be sent to Dairen.

"It will be as well not to believe that the Dairen bean trade will go on increasing without any limit, simply because affairs are in a flourishing state at present. If the demand for beans increases the production will increase in the north rather than in the south, and more especially in the newly cultivated lands of the Amur district, from Marken to the north bank of the Sungari, which has an area of about 6,665,000 acres, of which one-quarter is cultivated."

The foregoing has been quoted fully, as it gives a very fair idea not only of the possibilities of Manchuria as a producer of beans, but of the share in the trade that is likely to be taken by the three ports of Newchwang, Dairen and Vladivostok. The figures admittedly are not precisely accurate, and, from what information has come to hand since the article was written towards the end of 1908, they may be considered as under rather than over the mark.

FIBRES.

CULTIVATION OF TREE COTTONS.

(From the *Agricultural Journal of India*, Vol. IV., Part III.)

Tree cotton is a perennial variety which may occupy the ground for some years.

The method of cultivation should, therefore, approximate more closely to that of fruit orchards than to that of ordinary field crops.

The seedlings should, therefore, be grown from seed sown in threes or fours in well-prepared soil in centres 6 feet more or less apart, or on a well-prepared nursery on a well-drained site. The seed should be sown in this nursery in March at distances of 3 inches, and the plants should be watered. In June-July (beginning of the monsoon) strong young plants will be ready to transplant into their permanent homes. They should be planted out at distances of from 5′ × 5′ to 7′ × 7′ apart according to variety in holes dug to a depth of about 1½ to 2 feet. Care must be taken not to injure the tap-root of the plants in moving them from the nursery. An alternative method which is not costly and which avoids risks in transplanting, is to sow the seed in baskets made of bamboo about 8″ high and 4″ broad, placed close together with the places between the baskets filled up with earth. The whole space thus occupied can be watered either by hand or by flow irrigation. The seedlings should be sheltered from hot winds.

When the time for planting has arrived, each seedling can easily be removed from the basket without disturbing the roots to any extent, and to less extent than if grown in earthen pots. Well-rotted cowdung manure should be freely mixed with the soil of the hole in which each plant is permanently planted. The usual showers in India throughout July, August and September should give the plants a good start. An alternative system for trial would be to sow the seed in basket or in nursery in July and plant out in September.

In land which is liable to be flooded during heavy rains, it is recommended that the seedlings should be planted out on small raised hillocks or on ridges.

This very general advice about tree cotton cultivation is given with diffidence because, except under very favourable conditions, the cultivation of tree cottons on demonstration areas has not been successful in India.

The plantations usually, even in return for expensive cultivation, only give a very small outturn during the first two years, and a very uncertain crop afterwards. It is possible to grow profitably a catch crop (by preference a leguminous crop) between the rows in the first season.

It is advisable that twelve months after sowing, and just before the rains, the trees should be cut down to the lower branches, and pruning should be done each year just before the beginning of the monsoon, so that new branches will bear in the following cold weather. This pruning will check the trees from bearing all the year round, which is an inconvenience, as during the rainy season the cotton bolls are damaged, and besides, the trees should have an annual rest.

After the trees have become established, they require only occasional manuring if the soil is fertile, but the plantations must be kept free of grass weeds and undergrowth.

One chief care is to fight insect pests, to which tree cotton is very susceptible. The pests, when once established, are difficult to get rid of because the trees are perennial.—(EDITOR).

COTTON SEED.

WEIGHT AS A FACTOR IN SELECTION.

(From the *Indian Trade Journal*, Vol. XV., No. 191, November 25, 1909.)

Although it has long been known that the heaviness of the seed used for sowing is closely connected with the vigour of the resulting plants and with the yield and quality of the crops, yet the point does not appear to have received so much attention from agriculturists as it undoubtedly deserves. It has been shown by numerous investigators, both in Europe and America, that, under similar conditions, larger crops of the cereals are produced from heavy seed than from lighter seed of the same variety, and the fact has been established that in most, if not all, cases, the time, labour and expenditure involved in the selection of heavy seed for planting are amply repaid by the enhanced value of the crops.

The superiority of heavy seed is, of course, due to the larger quantity of reserve material which it contains, and which is available for the nourishment of the plant, thereby enabling it to

develop more rapidly, and endowing it with more vigour and disease-resisting power.

The following are some of the chief advantages gained by the use of heavy seed. The seeds usually germinate more quickly and produce hardier and more vigorous plants than the lighter seeds, and the crops produced are larger and more uniform. These facts were strikingly brought out by experiments which were carried out in a greenhouse some years ago by Messrs. Gilbert H. Hicks and John C. Dabney, and described in the *Yearbook of the United States Department of Agriculture*, 1896, page 305. The seeds then tested were those of garden peas, beans, hairy vetch, rye, barley, wheat and oats. In each case two specimens were carefully selected, one of heavy, the other of light, seed, the individual seeds of each specimen having approximately the same weight. The seeds were sown in pure sand, and the plants from each specimen were given equal quantities of a culture solution containing all the necessary elements of plant food. They were kept under exactly the same conditions, and at the conclusion of each experiment typical plants from each set were carefully removed, and weighed and measured. In every instance the seedlings from the heavier seed were of greater weight, the difference being closely proportional to the difference between the weights of the seeds. Seedlings from the heavier seeds exhibited greater vigour, were taller, bore a larger number of leaves, and had thicker stems and better developed roots. The plants made better growth in every way and produced larger and earlier crop than those from the lighter seeds.

Similar results have been obtained with tobacco seed. Comparative tests, which were made by Mr. A. D. Shamel (*Yearbook of the United States Department of Agriculture*, 1904, page 440), showed that the large, heavy seed always yielded the best developed and most vigorous plants, whilst the light seed furnished small, weak, and irregular plants. A sample of Cuban seed was separated into three grades—light, medium, and heavy. The heavy seed germinated almost perfectly, whereas less than 5 per cent. of the light seed germinated. The plants from the heavy seed grew more rapidly than those from the light seed, and were ready for transplanting seven to nine days earlier than the latter. The plants from the heavier seed were also hardier and more uniform.

The separation of the heavier and larger seeds is most commonly effected by means of sieves of suitable mesh. A partial separation can also be made by throwing the seed into water or a solution of salt, allowing the heavy seeds to settle, and skimming off and rejecting the lighter seeds. This plan is not altogether satisfactory owing to the adhesion of air bubbles to some of the heavy seeds, thereby rendering them buoyant. The seeds must be immediately dried after removal from the liquid. Another method, and one which was successfully employed in the separation of the tobacco seed used for the experiments mentioned above, depends on the use of a current of air. A foot-bellows is connected by means of rubber tubing to the lower end of a vertical glass tube. The strength of the air-current is regulated by means of a valve, which is so adjusted that, on blowing air through a quantity of seed contained in the glass tube, only the dirt, chaff and light seed are ejected.

The study of the advantages accruing from the use of heavy seed has now been extended to cotton, and an account of the results of work in this direction has been given recently by Dr. Herbert J. Webber and Mr. E. B. Boykin (*Farmers' Bulletin*, No. 285, *United States Department of Agriculture*, 1907).

The methods of separating the heavy seed which have just been mentioned are not applicable to American Upland cottons owing to the dense fuzz or down on the surface of the seeds which causes them to cling together. An ingenious and satisfactory method has now been devised, however, and has been used with very successful results in the experiments under consideration. In order to prevent the seeds from adhering together, the fuzz must be pasted down in some way. In the preliminary experiments it was found that this could be effected by rolling the seeds with water and some powdered substance, such as ashes, acid phosphate, or fine dry earth. Later, however, it was found more satisfactory to use paste made by mixing evenly $4\frac{1}{2}$ to 5 oz. of flour with a pint of water, then adding a quart of water and boiling until the liquid thickened. The paste is applied in the following manner. One bushel of cotton seed is placed in the rolling apparatus, which consists of a hexagonal wooden box with an axle running through it, the latter being supported at the two ends, and furnished at one end with a crank for rotating the box. The paste is poured over the seed in the box, which is then closed and rotated for from 7 to 10 minutes. The seed is afterwards removed from the rolling apparatus and spread out to dry. The seeds do not stick together

as would be expected, but remain quite distinct, each one being coated with a pellicle, which cements the fuzz closely to the surface and thus allows the seeds to separate freely from one another. This method of treating the seed is not only useful for enabling a separation to be made of the heavy from the light seed, but also facilitates sowing, as a uniform number of seeds can be readily dropped at regular distances, and thus obviates the necessity for thinning out the young plants.

For separating the heavy seed, a special form of air-blast fanning mill is recommended. The seeds prepared in the manner described are fed from a hopper on to a vibrating screen, which catches large wads of cotton or foreign substances and discharges them, but allows the cotton seed to pass through its meshes to another vibrating screen, with fine meshes. From this latter screen the seeds are delivered into a short flue, where they meet a current of air driven by a fan from below, which forces the light seeds out through the top of the flue, but allows the heavy ones to drop into a box below. The separation, thus effected, does not altogether correspond with the actual weight or size of the seed, but depends to some extent on its specific gravity, but this is probably an advantage, as the seeds of high specific gravity are obviously more desirable than large seeds, which have imperfectly developed or withered kernels.

Some experiments have been made with cotton seeds which were separated into heavy, medium, light, and very light grades. A much larger proportion of the heavy seeds germinated than of the light seeds, but the latter germinated more quickly. The plants from the light seed appeared weak and unhealthy, whilst those from the heavy seed were strong and vigorous.

A trial was made on about two acres of land in South Carolina in which heavy seeds and unseparated seeds of the same variety were planted in alternate rows. The heavy seed yielded a crop of 1,047½ lbs., and the unseparated seed a crop of 944½ lbs. In another trial one acre was planted with heavy seed and another with unseparated seed; a yield of 1,164½ lbs. was obtained from the former, and 1,075½ lbs. from the latter. Both these tests were carried out under ordinary field conditions, and showed that the crop is increased by about 10 per cent. by the use of heavy seed.

The evidence so far obtained has shown that this simple method of separating the heavy seed for sowing is not only likely to increase directly the profits of the cotton farmer, but will probably also be found to check deterioration and effect a general improvement in the varieties grown.

METHOD OF ESTIMATING THE YIELD OF COTTON IN THE FIELD.

(From the *Queensland Agricultural Journal*, Vol. XXII., Pt. 5, May, 1909.)

To estimate the yield of cotton from the plants in the field, the following directions, says Mr. J. C. Crawford, Special Agent, U.S. Bureau of Entomology, will be found useful:—

Determine the average number of sound bolls per plant by counting the number of such bolls on some five adjacent plants in at least three separate places in the field, and dividing the total number of bolls counted in this manner by the total number of plants examined. Where the field is very large or contains different soils, more than three places should be selected for counting. In the first column of the following table find the distance between the plants in the field, the crop of which is to be estimated. Then refer to the number on the same line in the following column, headed by the size of bolls to which the variety planted belongs. Dividing the average number of bolls per plant in the field by the number found in this manner in the table will give the fraction of a bale per acre that will be produced.

Example.—If, in the case of a small-boll variety like the King, the average number of bolls per plant is found to be 10, and the plants are put in at a distance of 2 ft. in rows, 4 ft. apart, the amount of the prospective yield per acre will be 10 divided by 25·4 or 0·39 of a bale. In using this table, due allowance must be made for a poor stand :—

NUMBER OF COTTON BOLLS PER PLANT OF VARIOUS CLASSES REQUIRED AT CERTAIN DISTANCES TO PRODUCE A BALE PER ACRE WHEN COTTON GIVES 33⅓ PER CENT. OF LINT.

Distance between Plants in feet.	Number of Plants per acre.	Large Bolls, 50 to 65 per lb.	Medium-sized Bolls, 70 to 80 per lb.	Small Bolls, 85 to 100 per lb.
1 × 3	14,520	5·9	7·7	9·5
1 × 4	10,890	7·9	10·3	12·7
1 × 5	8,712	9·8	12·9	15·9
1 × 6	7,260	11·8	15·4	19·1
1½ × 3	9,680	8·9	11·6	14·0
1½ × 4	7,260	11·8	15·4	19·1
1½ × 5	5,808	14·8	19·3	23·8
1½ × 6	4,840	17·8	23·2	28·6
2 × 2	10,890	7·9	10·3	12·7
2 × 3	7,260	11·8	15·4	19·1
2 × 4	5,445	15·8	20·6	25·4
2 × 5	4,356	19·7	25·8	31·8
2 × 6	3,630	23·2	30·9	38·4
3 × 3	4,840	17·8	23·2	28·6

SANSEVIERIA.

(From the *Agricultural News*, Vol. VIII., No. 186, June 12, 1909.)

Many species of Sansevieria are known, of which the chief may be regarded as *Sansevieria guineensis*, the kind common in Barbados and other West Indian islands, and *S. longiflora*.

S. guineensis is native to Western and Central Africa, where some efforts have lately been made to start an industry in its cultivation, and in the preparation of its fibre.

Although the fibres of certain species of Sansevieria undoubtedly possess very considerable utility, and are fitted for certain economic uses, yet it does not appear that at present any appreciable quantity of this fibre is placed on the market. A grower bringing forward this product would probably find difficulty at first in persuading dealers to purchase, and the Sansevieria would have to displace other fibres.

The best fibres are, of course, obtained from the longest leaves, and in order to encourage a profuse growth of large Sansevieria leaves, it is necessary to provide a certain amount of shade. It will be observed that plants growing in the open yield short, small leaves, as compared with those that are provided with congenial shade. On the Zambesi in Africa, it grows abundantly, but always does best when 'keeping to the shade of woods,' and in moist situations. Hence it would appear that in an island like Barbados, ill supplied with trees and bush, the conditions are not favourable to the production of leaves of the best quality.

Owing to the fact that the produce of these plants does not occur largely in commerce, there exist little reliable data as to returns that may be expected. The first cuttings of leaves would not be obtained, however, until at the expiry of some three years from planting, In Jamaica, according to an estimate made by Sir Daniel Morris, so much as 1½ tons of dry fibre per acre per annum might be expected under favourable conditions, after the period when cutting has begun. Since the leaves yield only about 3 per cent. of fibre, this would represent a crop of 50 tons of leaves per acre per year to be dealt with.

When once established, the Sansevieria plants are permanent.

Sansevieria fibres are soft, silky, elastic and strong, and possibly, when better known, they may come to occupy a more prominent place in the market.

In his lectures on 'Fibres and Fibre Plants,' however, Sir D. Morris gives it as his opinion that 'in competition with Manila and Sisal hemps, the fibre of Sansevieria has possibly little future before it.' The fibre from *S. guineensis* somewhat resembles the valuable Manila hemp (from *Musa textilis*), and is used for cordage purposes.

The most varied figures have been quoted by dealers, and at the Imperial Institute, London, as representing the value of different samples of fibre from *Sansevieria guineensis*. These have ranged from £20 to as much as £60 per ton. Most of the valuations that have been made, however, have been of a nominal character. A good deal depends upon the length and uniformity of the staple, and the care with which the fibre has been prepared and cleaned. A good length of staple is about 3 feet 9 inches long.

The sample of fibre for which the valuation of £60 per ton was quoted, was received at the Imperial Institute about a year ago from the Gold Coast, West Africa. This was described as 'consisting of soft, clean, white, well-prepared fibre, which was fine, of good lustre, of fairly even diameter, and of good strength. The product was about 3 feet 9 inches long, and was of excellent quality, suitable for use with the finest Manila hemp.'

COTTON CULTIVATION IN TINNEVELLY.

(From the *Indian Agriculturist*, Vol. XXXIV., No. 7, July 1, 1909.)

Mr. H. C. Sampson, Deputy Director of Agriculture, Madras, contributes a very informing paper to the current number of that very excellent periodical, the *Agricultural Journal of India*, on the introduction of drill sowing and inter-cultivation on the black cotton soils of Tinnevelly. In 1907-08, the Government of Madras gave an allotment of Rs. 5,000 for the improvement of cotton cultivation, and it was decided that a part of this sum should be utilised in introducing the practice of drill cultivation for cotton into the Tinnevelly District. To some extent the way had been prepared. This method of cultivation had been introduced on to the Koilpatty Agricultural Station, and in the 1906-07 seasons, after the station had been enlarged, there were 51·35 acres of cotton all sown with the drill. The crops which were much superior to those outside the farm began to attract atten-

tion in the neighbourhood. In March, 1907, when the cotton-picking was at its height, Mr. Couchman, Director of Agriculture, and Mr. Wood, Deputy Director of Agriculture, who then had charge of this division when inspecting this station, assembled the neighbouring ryots. The methods of cultivation were explained to them, the farm crops were compared with those outside, and the implements were shown at work and even handled by the ryots. Several of them there and then promised to try this method of cultivation if assistance were given them. The very roughness in the workmanship of the implements pleased them, as such work could easily be turned out by their own carpenters and blacksmiths. But there were many obstacles to be overcome before such a revolutionary change in the methods of cultivation could be brought about. Instead of sowing cotton broadcast, covering with the plough and doing the after-cultivation with hand-hoes, it was sought to introduce the practice of sowing in rows with the bamboo seed-drill covering the seed with the blade cultivator and doing the after-cultivation with the small blade bullock-hoes. All these implements, though common in the Northern Districts and in other parts of India, are unknown in the south of Madras. When it was decided to take steps to introduce this system of cultivation, there were only two coolies in the District who knew how to work these implements, and these were only local men who had been trained on the Koilpatty Agricultural Station, and who only knew that particular class of soil. Therefore, it was decided to bring down men who had been used, all their lives, to these implements from the Bellary District. Accordingly, some 26 sets of implements were made during the hot-weather months, ready to be lent out to ryots, and six Bellary men were sent down at the beginning of September (six weeks before the sowing season). In the first year, about 200 acres were sown on ryots' fields with the drill. In the year 1908-09, a similar allotment was made for cotton improvement, and it was decided to continue this work as well as to introduce seed farms for growing pure Karangani cotton of the strain selected on the Koilpatty Agricultural Station. This gave an opportunity of spreading this system of cultivation further afield than Koilpatty, but was a much more difficult matter to arrange, as in many parts of the District, the Department was unknown, and the Agricultural Station at Koilpatty had not been heard of. In order to cope with this work as well as the extension, probably on the success of the previous year's operations, several new hands had to be trained. This meant a very careful selection. Apart from the seed farms and demonstration plots, there has been a rapid extension of drill sowing in the villages around Koilpatty, where some 500 acres have been sown. One village alone accounted for more than 230 acres, while two more each had over 70 acres. In a few cases outlying ryots have also sown, having either seen the farm crops last year or the crops of ryots who had sown with the drill the previous season. Including the seed farms there is an area of about 1,000 acres this year sown with the drill. The mere fact of sowing is, however, by no means everything. Each "ryot" who has sown has to be seen constantly. He has to be induced to thin, and shown, when and how, to use the bullock-hoe. As the thinning and, very often, the hoeing clash with other farm-work, the "ryots" are often unwilling at the time to do so. This means considerable patience and tact in dealing with them. Thinning especially goes against the grain, for the "ryot" says, "It is like taking the life of my children to pull these plants which have grown," but still this must be done if this system of cultivation is not to degenerate into that of the Bellary District where the seed-rate is more than double that used in Tinnevelly and no thinning is done. Many of the wives and children of the Koilpatty cooly staff who are employed for casual labour on the Agricultural Station, were sent out with one of the Assistant Managers to show "ryots" how to thin their crops. Small boys are probably the best, as their youth favours them in their training, and they can do the work with that unconscious confidence which always appeals to a "ryot." With all the success already obtained in this introduction it is by no means certain yet whether this method of cultivation, if now left to itself, would last. The questions which next present themselves are: (1) when should the Department withdraw its help, and (2) how to leave the work on a substantial basis. This is, of course, looking into the future, but it seems necessary that the Department should give some concession, if the "ryots" do the same. The proposal next season is that the Department should lend one set of implements to the village for every one that the village is prepared to make, provided that 10 acres are sown with the two sets, and if the villagers themselves guarantee to sow 200 acres with the drill, the service of a trained coolie will be lent to them for the season.

WEST INDIAN COTTON.

(From the *Agricultural News*, Vol. VIII., No. 197, November 13, 1909.)

Messrs. Wolstenholme and Holland, of Liverpool, write as follows, under date October 25, with reference to the sales of West Indian Sea Island cotton :—

Since our last report, no business is reported in West Indian Sea Island cotton, owing to the absence of stock.

Amerian Sea Island cotton of all descriptions continues to harden gradually. For 'Fine' Island they are asking 16½*d.* and 'Fully Fine' 17½*d.*, but no business is passing at these rates, buyers' ideas being rather lower. The best Floridas are worth 13¾*d.* to 14*d.*

The report of Messrs. Henry W. Frost & Co., on Sea Island cotton in the Southern States, for the week ending October 23, is as follows :—

The market has been quiet throughout the week, without any sales being reported. There was some demand at the prices at which the opening sales were made, viz., Fine 28c., Fully Fine 30c., and Extra Fine 32c., which if factors had consented to accept would have resulted in fairly large sales; but factors advanced their prices 2c., which buyers refused to pay. Should the market remain quiet, with no demand at the advance asked, with the accumulation of stock, factors may in time have to recede from their advanced views.

EDIBLE PRODUCTS.

MANURIAL EXPERIMENTS WITH CACAO IN GRENADA.

(From the *Agricultural News*, Vol. VIII., No. 197, November 13, 1909.)

Interesting details of experiments in connexion with the manuring of cacao that have been conducted by Mr. W. M. Malins-Smith at Diamond estate, St. Mark's, Grenada, have been received from him. The results are given here for the benefit of readers of the *Agricultural News*. While this is done, the Department does not hold itself responsible for the statements which are made with respect to any proprietary chemical manure.

The manurial treatment (according to the table supplied by Mr. Malins-Smith) on the different sections was as follows :—

Section 1: 1907.—Basic slag, 8 cwt. (April); sulphate of potash, 2 cwt. (May); sulphate of ammonia, 2 cwt. (September).

Section 2: 1907.—Swift's tropical manure, 10 cwt. (June).

Section 3: 1907.—Sheep manure, 2¼ tons (April).

Section 4: 1907.—Wood ashes, 4 hogsheads (April); sulphate of ammonia, 2 cwt. (September).

Section 5: control; no manure.

Section 6: 1907.—Lime, 1¾ hogsheads (April). 1908.—Pen manure, 20 tons (May).

Section 7: 1907.—Lime, 1¾ hogsheads (April); sulphate of ammonia, 1½ cwt. (September), 1908.—Basic slag, 4 cwt. (May).

Section 8: 1907.—T.S.G. cacao manure, 10 cwt. (June).

These experiments in manuring were begun in 1907 for the purpose of testing the relative value of several complete manures and combinations of fertilizers on large areas of excellent bearing cacao which had not been manured or forked for several years, and which at the time was giving a yield of 5 bags of 180 lb. each per acre.

In March-April, 1007, the plots were carefully forked and all dead leaves, weedings, etc. were buried. The manure was then applied broadcast on the surface, evenly distributed throughout the plots. The trees were then carefully, but lightly, pruned, the prunings being left on the ground to serve as a mulch over the manure. In June, the plots were weeded and all dead leaves and prunings were carefully buried near the surface of the soil. From June to September all suckers were removed from the trees and the drains in the field cleaned out. In 1908, the manurial treatment was not repeated, and the only manure applied that year was that used in completing the combinations in sections 6 and 7. Cultural work done in 1908 comprised the burying or 'bedding' of all weedings, dead leaves and prunings in the month of June; light pruning; removing suckers; cleaning drains; weeding, etc. These plots were established on a basis of equality in cost of manures and area. Each plot was carefully measured to one acre; they are all adjacent to one another. A sum of £5 was spent in manures on sections 1, 2, 3, and 8.

The wood ashes applied to section 4, being a by-product of the estate, cost nothing. The same may be said of the

pen manure applied to section 6, except that it cost £2 for application. The cost of applying manure to the other sections was only 2*s.* to 2*s.* 6*d.* per acre. In section 7, only £3 15*s.* was spent on manures. The same amount was spent on every section for cultural work, *i.e.*, £8 10*s.* for the period from April, 1907, to August, 1909. The figures given in the table of results are for the period of two years' crop—September, 1907, to August, 1909, inclusive.

It will be observed that the yield of the control section increased by $1\frac{1}{3}$ bags in the first year over the previous average yield of the field. This, presumably, was due to the forking and bedding. With the exception of Nos. 1 and 7, all the sections dropped one bag in the second year.

The experiments tend to prove the great advantage which accrues from manuring even good, bearing cacao, and that an average yield per acre of 5 bags of 180 lb. each, which most planters agree is excellent, can be easily increased by 50 per cent., leaving a big increase in profits to the planter. They also prove the superiority of T. S. G. cacao manure, and show that it is the most profitable complete manure that can be used for cacao.

RESULTS.

Section.	Cost of manure. £. s.	Cost of cultivation. £. s.	Yield in bags. 1st year.	2nd year.	Total.	Increased yield, in bags.	Profit (on no manure). (At £4 per bag.) £. s. d.
1	5 0	8 10	$5\frac{1}{2}$	$5\frac{1}{2}$	11	— $\frac{1}{3}$	—6 6 8
2	5 0	,,	$7\frac{2}{3}$	$6\frac{2}{3}$	$14\frac{1}{3}$	+ 3	+ 7 0 0
3	5 0	,,	8	7	15	+ $3\frac{2}{3}$	+ 9 13 4
4	1 12	,,	$7\frac{1}{2}$	$6\frac{1}{2}$	14	+ $2\frac{2}{3}$	+ 9 1 4
5	— 0	,,	$6\frac{1}{3}$	5	$11\frac{1}{3}$	—	—
6	4 5	,,	$8\frac{1}{4}$	$7\frac{1}{4}$	$15\frac{1}{2}$	+ $4\frac{1}{6}$	+ 12 8 4
7	3 15	,,	$5\frac{3}{4}$	$5\frac{3}{4}$	$11\frac{1}{2}$	+ $\frac{1}{6}$	—3 1 8
8	5 0	,,	9	8	17	+ $5\frac{2}{3}$	+ 17 13 4

A RUSSIAN METHOD OF CORN CULTIVATION.

(From the *Journal of the Board of Agriculture*, Vol. XVI., No. 9, December, 1909.)

A method of growing corn has recently been advocated in Russia which, although it is not likely to be suitable in cultivating large areas in this country, might prove useful in growing corn for seed or other special purposes. It has also been suggested that it might be adopted by small holders, as it would enable them to grow a heavier and better crop on a small area.

The method, which, broadly speaking, depends on the careful cultivation of each individual plant, is not new, as it has often been proposed in the past in this country, and constitutes the ordinary practice in China at the present day. The large amount of labour required makes it inapplicable for ordinary corn growing except in countries where labour is very cheap and very plentiful.

The author of the system (M. Demtschinsky) states that farming in Russia is giving more and more unsatisfactory results, and in consequence famines, formerly of rare occurrence, have become less common. The number of livestock in the country is not enough to provide sufficient manure, while the introduction of a rotation of crops apparently presents great difficulties, so that it is necessary to find some other means of increasing the low average yield of corn.

For this purpose he suggests the practice of earthing-up, or alternatively that of deep-setting or transplanting, the object in any case being to develop root-action and increase the tillering power, so that a greater return is obtained.

In the case of earthing-up, the land would be prepared in the usual way, and the sowing done by a hand or horse drill, a little artificial manure being applied, if possible, at the same time. The drill should be arranged so as to sow three rows $3\frac{1}{2}$-$4\frac{1}{2}$ inches apart, leaving a distance of $10\frac{1}{2}$-14 inches between each third row to give room for working. The greater distance is necessary when a horse hoe is to be employed.

About a month after sowing, when the young plant has appeared and begins to send out shoots, the first earthing-up should be done. This stage is a critical one in the field of the plant, and by heaping up the earth round it the plant is protected from drought, frost, and other unfavourable influences, the tillering shoots multiply and the roots develop to a very greater extent than they otherwise would.

The process of earthing-up may all carried out with a machine like a smbe hand hoe or cultivator, the tines of which are arranged so as to throw the earth between the rows over the plants on each side, while the outside tines cover the outside of the rows. A simple instrument suitable for working three

rows at a time may be made something like a large rake by fixing four suitable blades at the proper distances on a beau or head which is fitted with a handle and can be pulled steadily along the rows. This presses up the earth round the plants, and also serves to eradicate weeds. A week or ten days afterwards, if the plants can be seen to have grown, the process can be repeated. A final earthing-up is recommended some months later in the case of winter crops.

A number of experiments have been conducted in Russia, and the results obtained in two cases are given in M. Demtschinsky's pamphlet.

One experiment with oats was carried out in the province of Kursk on a plot 163 square yards in extent. The sowing was done by a hand-drill on the 5th April, the first earthing-up on the 7th and 8th of May, and the second about June 10th.

The plants were covered to a depth of $1\frac{3}{4}$ inches at each operation, and on 20th July the ground was hoed for weeds. In the middle of May the oats were about 12 inches high, flowers appeared at the beginning of June, and as early as the end of the month the ears began to appear. The crop was reaped by the end of July; a yield of $190\frac{1}{2}$ lb. was obtained from 163 square yards.

This, as M. Demtschinsky points out, is equivalent to 145 bushels per acre (39 lb. to the bushel), but no accurate conclusions can be drawn from so small an area.

An experiment on a large scale in the province of Kursk is also mentioned. Here barley was grown and a crop of 45 bushels per acre (50 lb. to the bushel) was obtained by earthing-up, as against $33\frac{1}{2}$ bushels by ordinary cultivation. The expenditure is stated to have been practically the same in both cases.

The second method which is advocated is that of transplanting and deep-setting. The seed can be sown either broadcast or in rows at a distance of $1\frac{3}{4}$ inches apart in the row. The latter method is the better, as the plants are more even in size.

The transplanting is done in the same way as with young cabbages. It is recommended that the earth should be shaken from the roots, and the plants placed upright in a shallow box, the bottom of which is covered with basic slag. When the box is full it can be taken to the field and the planting done in rows, allowing 7 inches between the rows and 7 inches between each plant. The plants should be put in deeply, about three-quarters of an inch lower than before, so as to cover the base of the leaves. If the weather be dry the plants may be watered with weak liquid manure.

Another method of deep-setting without transplanting may be adopted if the seed is sown in rows at even distances apart. The work is done with two dibbles, one of which is hollowed at the end like a scoop. When the plants are of suitable size, the dibble with the scoop-like end is inserted under the roots of the plants so as to raise it slightly, while at the same time an ordinary dibble is inserted on the other side of the plant to the required depth. The result is that the plant sinks lower in the soil and the loose earth can be heaped up round it.

A number of trials have been made in Germany for the purpose of testing the method. One of the most exhaustive, which was carried out at the Agricultural Institute at Bromberg, is reported in the *Mitteilungen der Deutschen Land-Gesellschaft* (9th October, 1909). Duplicate plots were arranged with both rye and barley. The rye plots were arranged as follows:—(*a*) drilled in rows 6 inches apart in the ordinary way; (*b*) planted in rows 10 cm. (nearly 4 inches) between the rows and 20 cm. (nearly 8 inches) between the plants; (*c*) drilled in sets of three rows 10 cm. apart with a distance of 30 cm. (nearly 12 inches) between each three rows; (*d*) drilled as in the case of (*c*), but the plants afterwards thinned to 8 inches apart as in (*b*).

In the case of the rye, the sowing of (*a*), (*c*) and (*d*) took place on 22nd September, and for (*b*) on the 3rd September, the plants being transplanted on the 24th. The latter suffered from drought and did not recover till the beginning of October. On the 14th October the (*d*) plots were thinned, and on the 17th both (*c*) and (*d*) were earthed-up. The winter was severe and only about forty per cent. of the transplanted seed (*b*) survived, whereas (*c*) and (*d*) suffered but little. The development of the roots and shoots on (*b*) was, however, much better than any of the other plots, and when the crop was reaped the number of stalks per plant on (*b*) averaged 10, as against 4 on (*a*), 7 on (*c*), and 8 on (*d*.) The number of full years per plant and the number of grains in the ear were also greater than on the other plots.

The average results are given in the following table:—

	Rye. Grain, Bushels, (60 lb.) per acre.	Rye. Straw, cwt. per acre.	Barley. Grain, Bushels, (50 lb.) per acre.	Barley. Straw, cwt. per acre.
a. Ordinary Cultivation	49·6	34·6	56·3	27·6
b. Transplanted	32·1	22·7	6·6	10·7
c. Earthed-up	52·4	34·2	70·5	35·5
d. Thinned out and earthed-up	35·2	25·8	56·4	28·5

It will be seen that the transplanted rye gave the smallest yield, which was attributable to the widest planting in the first instance, and was further reduced by the thinning-out caused by the unfavourable winter. The same reason accounts for the poor yield on (*d*). The yield, however, of the earthed-up plants on plots (*c*) differs very little from plot (*a*) and could not be regarded as remunerative.

In the case of barley, the arrangement of the plots was the same, but the distance between the plots and rows was somewhat different. In plot (*a*) the rows were 12·5 cm. (nearly 5 inches) apart; in plot (*b*) the transplanting was done in four rows 7 cm. (2¾ inches) apart; with an interval of 30 cm. (nearly 12 inches) between each set of rows, the plants being 10 cm. (nearly 4 inches) apart; in plot (*c*) five rows were drilled about 8 inches apart with an interval of 12 inches between each set of five rows; on plot (*d*) the rows were drilled in the same way, and the plants were thinned out to 4 inches apart.

Sowing was done on 8th April, transplanting on the 4th May, thinning-out and earthing-up on the 11th May. The transplanted seedlings suffered very much from unusual drought in May, and only a small proportion survived. The crop on plants (*c*) and (*d*) grew somewhat more slowly than that on plot (*a*), but a thoroughly good stand was secured. The tillering was greatest on plot (*d*), where the plants were thinned-out and earthed-up, an average of 12 stalks per plant with 10 full ears being obtained, while plot (*c*), which was earthed-up, gave 10 stalks per plant with 9 full ears.

The results as regards yield are included in the table above. As has been stated, plot (*b*) was a failure, and Herr Kruger in reporting on the experiments observes that in his opinion the transplantation of spring-sown cereals would only be successful in exceptional cases in Germany, where the weather in May and June is usually dry.

Owing to the distance of the plants apart on plot (*d*) the yield, though excellent individually, was only equal for the whole area to that obtained on plot (*a*) by ordinary cultivation. On plot (*c*), however, where the rows were earthed-up, a high yield was obtained, which exceeded the yield on plot (*a*) by 14 bushels of grain and nearly 8 cwt. of straw, a return which would amply justify the extra labour involved.

THE MANGO.*

BY H. H. COUSINS,

(From the *Philippine Agricultural Review*, Vol. II., December 12, 1909.)

Some two years ago, the late Capt. L. D. Baker, the founder of the banana trade in Jamaica, came to Hope Gardens and stated his opinion that the department would be wise to devote a large part of its energies for some years to come to furthering an export in mangoes. "You grow the mangoes," said Capt. Baker, "and I will build the ships to carry them."

Further attention to the possibilities of the mango as an article of export from Jamaica has resulted from the remarkable returns recently obtained by Mr. Aston W. Gardner of Kingston in shipping high-class mangoes to London. Some years ago Mr. Gardner obtained through the kindness of Sir Henry Blake, the Governor at the time, some newly-received plants of grafted mangoes from India. One of these has now grown into a fine tree and produces large crops of a very choice mango that is not in the collection of mangoes grown by the department. During the past season Mr. Gardner shipped these fruits to England and received £70 for the produce of this one tree. The prices varied from 1*s*. 6*d*. to 2*s*. 6*d*. per fruit. During the past season we have sent from Hope to various expert horticulturists in America samples of all the ordinary varieties of mangoes grown in Jamaica.

The common mangoes, kidney mangoes, and black mangoes carried badly and were not appreciated, while "No. 11" was considered a superior fruit. The best results both in keeping and in edible properties were invariably obtained with the "Bombay" mango† in-

*From "The Porto Rico Horticultural News," July, 1909.

†Retail prices in New York on the new Bombay Governeur mango, weighing from a pound to a pound and a quarter, range from $1 to $1·50 each. Ordinary Bombay mangoes are quoted at 50 cents each.

troduced into Jamaica by Governor Sir John Peter Grant, and known in other West Indian colonies as "Peter's." This mango is free from fibre, has a small stone and possesses a delightful subacid flavour with a mellow luscious quality that surpasses all other mangoes grown in Jamaica. I am inclined to the opinion, therefore, that Sir Peter's Bombay mango is the most promising variety to grow for export. It is a hardy tree of prolific bearing and frequently fruits quite freely out of season when mangoes should be in great demand in America. Remarkable success has frequently been achieved in shipping this fruit to America and England, and its keeping qualities are exceptional.

Varieties of Mangoes.—An exhaustible account of the history of the mango in Jamaica and a description of all the varieties then growing in the island by Mr. W. Harris, F.L.S., was published in the Bulletin for 1901, pages 161 to 178. Practically every mango tree in Jamaica is a seedling, and although certain varieties appear to come fairly true from seed, there is undoubtedly a constant variation and no two "No. 11" or "yam" mangoes are strictly alike.

It is very regrettable that the fine collection of Indian mangoes introduced by Sir John Peter Grant in 1869 was set out at Castleton Gardens. In this situation the moisture of the air is so great that the mango gets into an unhealthy state, and it is rarely possible for the flowers to be fertilised. Some of the varieties have not fruited yet, although forty years of age, and it must be admitted that the department has been very lacking in enterprise, until quite recently, in extending the best varieties of Indian mango in Jamaica.

In 1904, the idea of budding mangoes was suggested by the publication of some successful experiments in Queensland. Mr. T. J. Harris, of the Experiment Station, operated on these lines and was the first person to bud mangoes successfully in Jamaica. The original tree was a fairly large yam mango of a good age. The buds consist of "Bombay" and "Alphonso" varieties, and the rapid growth has enabled the new buds to restore the old tree to quite respectable dimensions at the end of the fourth year from budding. Fruit was borne for the first time when the buds were three years of age This experiment is one that demonstrates the great possibilities for budding mangoes in Jamaica, and it is hoped that during the next ten years many thousands of trees, at present bearing inferior fruit, may be converted into budded trees furnished with the choicest varieties of dessert fruit.

To test the practical aspects of the matter, it is now in contemplation to bud one thousand large seedling trees growing on the old slave quarters of the Hope estates, as part of the operations of the new farm school and thus secure a good trial of the possibilities of growing high-class Indian mangoes on ordinary wild trees. A stock of 105 grafted plants of the choicest varieties of Indian mangoes was obtained from the Calcutta Botanic Gardens and despatched by the immigrant ship *Ganges* in September last. The plants arrived in capital order and the department will now be able to propagate these esteemed varieties and have them tested in Jamaica. The following varieties have thus been added to our collection of mangoes: Alphonso, Bombay, Fuzli, Singapur, Madras, Langra, Kisenbhog, Kemsagua, and Malda.

As at present advised, the "Peter's Bombay" should be selected as the most promising variety for cultivation for the export trade.

The variety "Alphonso" or "Afooz" is highly esteemed in India. The late Colonel Griffith of Hodges, St. Elizabeth, imported at great cost, two trees of the Alphonso mango. It is possible, however, that "Alphonso" may prove too shy a bearer for profitable exportation in Jamaica, and its cultivation cannot at present be recommended. We have a large number of mangoes from all parts of the world under observation at Hope. So far, none have indicated any approach to "Peter's Bombay" as a commercial fruit. The majority are decidedly inferior varieties.

Hints on Culture.—The mango, when grown naturally from seed sends down a deep tap root and it is characteristic of young seedling mangoes that they root very deeply in the earliest stage of their growth. Experiments have shown that a good seed from a strong growing variety (planted at stake), will give far quicker results in establishing a tree than a seedling set out from a pot. Indeed, in a dry district, the establishment of a mango transferred from a pot to the soil is always a matter of considerable uncertainty. It is desirable, therefore, when setting out an orchard, to plant seeds of the yam or other strong-growing variety of mango. When these are $1\frac{1}{2}$ to 2 years old they should be stout little trees of just the right size for budding.

A distance of thirty to forty feet should be allowed between the trees when developed. For quick returns from budded trees it is recommended to plant 15 feet by 15 feet or 20 feet by 20 feet and to cut out every alternate tree when the growth requires it.

With the mango, the young buds are not of use for budding. The buds from wood 1½ to 2 years old showing leaf scars on the bare bark, should be selected. It is useless to attempt budding unless the bark lifts freely. When the trees are flushing, the bark can be lifted easily and there is no difficulty in removing the buds with the slips of excised bark. Buds can be inserted either by cutting out a corresponding piece on the bark of the branch to be treated, or the bud can be slipped under a T-shaped incision in the ordinary way. Raffia fibre is a good medium for tying in the buds.

In budding old trees, do not cut down the whole tree at once. The main branches should be cut off about a foot from the stem, taking care not to split the arm, smoothing the edge of the bark and protecting the cut surface with tar. When the new growth is 1 to 1½ inches in diameter it is fit to take a bud. When the buds have started to grow the rest of the bunches can be cut down and similarly treated.

It is important to observe that an old tree cut off short below the main branches will probably die, and that care is required in lopping old trees not to remove the whole of the foliage at one operation. When the new shoots have grown, the old stumps of the original branches should be carefully cut close back with a slope toward the trunk of the tree.

It is very important in pruning a mango tree to cut close to the main branch or stem so that the wound can heal rapidly. The bark should be bevelled with a sharp knife and the cut end treated with tar. Careless lopping of old trees will result in attacks of insects and fungi upon the exposed tissue, and the death of the trees will be greatly hastened.

As it is now proposed for the department to test budded mangoes on an area of over 800 acres of land, we should in a few years have definite results upon which the commercial basis of the high-class mango as an article of export from Jamaica can be determined. I am convinced that those planters who take up the work of improving the mango by budding in those districts of the island where it fruits well and freely, will reap a rich reward in the future.

The choice East Indian mango is not only a most grateful fruit to the palate of any normal person, but it also possesses a fascination for those who have acquired a taste for the fruit that bespeaks an ever-growing demand when this, the most luscious fruit of the tropics, is made accessible to the peoples of America and Europe.

PRODUCTION OF RICE IN THE UNITED STATES.

Figures given for the last few years (Tropenpflanzer, February, 1910, page 106) show :—

1901	...	388,000,000 lb.
1903	...	560,000,000 ,,
1904	...	586,000,000 ,,
1906	...	496,000,000 ,,
1907	...	520,000,000 ,,
1908	...	608,000,000 ,,

of this, 52·8 % was from Louisiana, 41·8 % from Texas.

THE TEA INDUSTRY.

SOME MODERN DEVELOPMENTS. II.

(From the *Indian Agriculturist*, Vol. XXXIV., No. 3, March, 1909.)

The tea bush differs from most other agricultural plants in that it is grown, with the exception of small plots for seed purposes, entirely for its leaves; and when it is remembered that the function of all vegetable growth is to produce seed, it will at once be seen that the tea bush has a duty to perform that is really against the laws of nature. And not only has the crop produced by the tea bush no analogy in the history of economic agriculture, but the process of harvesting it is in itself very nearly unique, and the gardener whose life has been spent amidst flower beds and orchards would find himself absolutely non-plussed if he were asked to gather the crop of the tea bush. The pruning of the tea bush would present no very great difficulties to his mind, for it is carried out on much the same lines as that for fruit growing, but the identity of agricultural procedure outside cultivation begins and ends there.

PLUCKING.

While the harvesting of the crop would appear to be a very simple process, and one in no way liable to error on the part of the producer, this is not the case. Plucking of tea as a fact is really a matter for very much more consideration than the collecting of most annual crops. In the first place the harvesting of the tea crop is not, as is the case with

cereals, and even with tropical plants similar to tea, such as coffee and cocoa, a single individual harvesting at one period of the year, but it is continued week by week through many months of the season. Again, it is not merely a question of taking the crop from the earth such as it is and being content with it, but it is one of choosing how much to take and how much to leave.

It is every planter's endeavour to reap from his bushes the greatest amount of good leaf possible, and to enable this to be done it has been found that better results in certain districts are made by sacrificing a certain amount of crop at the beginning of the year. It is an easy matter to pluck off the tea shoots as they appear in the bushes, but if this is done freely at the inception of the season the bush does not flush in the same way as if it was allowed to grow freely for the first month or so. This is one of the greatest points at which the Scientific Department has laboured since its establishment, and it is agreed that the saving of the bush at the beginning of the season is one of the greatest preventatives of deterioration, while it is at the same time a factor of first importance in regard to the immediate crop. Not only does care in long and luxuriant growth at the beginning of the season ensure thick straight wood for subsequent pruning, but it enables the bush to establish its mass of young growing rootlets, and it maintains a freer communication between the stems and the roots.

Plucking itself is as a rule a question of labour, and with a short labour force it is very much easier to pluck a bush hard than it is to allow free growth and to check it as desired. But here the question of close plucking intervenes, and it is now pretty well accepted by planters of intelligence that the secret of quality in tea, outside the question of manufacture, is in catching the leaf when it is young, as the shoots then contain greater percentages of the intrinsic essentials which go to make quality. Close plucking, however, as it was followed in the most north-easterly districts of Assam, and which tends to give the finest quality tea, has had to be given up because it was found that the system was too severe on the bushes. This system, which it is understood was called the Sadya Road System, consisted in plucking every shoot, no matter how much grown, as soon as it appeared, and it is easy to perceive that such a system was bound to tax the bush to its utmost. On the other hand, there is no reason why similar leaf to that obtained by the Sadya Road system should not be got by leaving the shoots to grow to a certain extent, and this is the standard to which planters are approaching now. Leaf only contains its different virtues during a certain period of life, and, that once reached, no good can be gained by leaving leaf on the bush once growing conditions are established.

The handling of leaf after it has been plucked is also a question which has exercised the minds of planters, and it is customary now to pay an amount of attention to the delivery of leaf in the factory in first-class condition that not so many years ago would have been considered absurd. It was at one time a question of crop; it is now quality first and crop if it is to be got.

PESTS AND BLIGHTS.

But if the Scientific Department has conferred upon the industry great benefit in the question of pruning and plucking, it has perhaps more than all justified its existence in work which it has carried on with regard to the treatment and mitigation of insect pests and blights. In this part of the work the Department has had a special field of enquiry to investigate which it has been able to do with the exactness and completeness which are the attributes of Science. There is no doubt that in the case of the Tea Industry blights have threatened to be one of the most serious checks to its successful development, and we have in the history of coffee growing in Ceylon an example of what insect blight can do in actually exterminating a large and influential agricultural industry. The Indian Tea Industry has been cruelly attacked by more than one blight, but up to the present time it has fortunately showed no signs of succumbing to any of the many perils to which it has been liable in its short existence.

It is recognised, of course, with all plants which are rescued from their jungle existence, which are brought into cultivation and closely associated with the other, that the dangers from individual blight and pests are intensified. Not only has the Tea bush been recovered from its natural surroundings in the jungle, but it has been forced to change its habits, and to a very great extent to outrage the system arranged for it by nature, so that this very change of habit tends to make the plant more liable to all diseases to which it is predisposed. Also the very fact that the plant is more intensively cultivated and more carefully treated renders it the more liable to disease, in the same way that any living thing which is cultivated for a special purpose becomes more delicate constitutionally.

To turn, however, to what has been done in the direction of guarding the plant against its natural enemies in the shape of insects and fungi, the planter has been put in possession of the history of each individual blight or pest as it arrived upon the scene of action. It can be easily understood that to combat a blight whose habits are known is a very different matter from fighting in the dark a somewhat insidious enemy whose antecedents cannot be traced, and whose methods of working are obscure and untraceable. The day was when the planter had to be satisfied in his mind that, when he was visited by a plague of caterpillars, the caterpillars were actually there on the bushes, and all he could do was to pick them off to the best of his ability and pray that he might not be visited by a recurrence of the evil. If the plague returned he looked upon it as a visitation of Providence, and while dimly aware that the same might be of the beneficent nature usually associated with that abstruse, indefinable, but kindly power, he once more did his best to defeat its benevolent purpose for the sake of his more practical and material benefactors —his shareholders—perhaps thinking that he was risking his own chance of Heaven in doing so. The publication of the ponderous volume on pests and blights by Sir George Watt and Dr. Mann, teeming with a mass of knowledge and information on these points, however, altered the planters' views altogether, and when caterpillar and other insect pests or fungus blights appear on his tea bushes to-day, he identifies the species by this book, and coolly proceeds to destroy the root of the evil by collecting and burning the larvæ of the insects or the mycelium of the fungus by the means advocated, thus taking precautions to prevent a further attack.

SIRDARI.

RICE CULTIVATION IN BURMA.

(From the *Indian Agriculturist,* Vol. XXXIV., No. 2, February 1, 1909.)

Mr. A. McKerrall, M.A., B.SC., the Deputy Director of Agriculture, Burma, has a very interesting contribution on rice cultivation in Lower Burma in the *Agricultural Journal of India.* Rice, as everyone knows, has long been the Province's chief staple of commerce and the most important item in its agriculture. Admirably adapted both as regards soil and climate for the production of this cereal, Burma is to-day the chief rice-growing country in the East, if not in the whole world. The export of rice for the year 1907-1908 may be put down at about 2½ million tons of cleaned cargo rice. The price of paddy went up as high as P. 168 per 100 baskets, and the new season's crop, this year, opened at P. 125 and P. 127. But the European millers combining, have managed to cause prices to fall to P. 100. However, as the season advances the price is bound to go higher. Last year, the great demand for the famine districts naturally caused an abnormal increase in prices; but this year conditions are more favourable in India, and there is, therefore, no reason why such high prices should be maintained.

Every year, almost, sees an increase of about 8 to 9 per cent. of land brought under paddy cultivation in Burma. Within the Deltaic areas, where the bulk of the rice crop is grown, the rainfall is plentiful, ranging from 97 inches in the Pegu district, including Rangoon and its neighbourhood, to 133 inches at Bassein, 198 inches at Akyab, and 214, 211 and 219 inches in the Amherst, Tavoy and Thaton districts, respectively. The rainfall lasts from April to November, or for a period of six and half to seven months. The soil is geologically termed *recent alluvium,* consisting of a stiff clay overlying a still stiffer clay subsoil, which in the hot weather

Assumes a Hardness Precluding Cultivation

of any kind at that season of the year. The remarkable feature of the soil is its ability to be cultivated year after year without manure and without seemingly exhausting its fertility. The only factors which keep it from becoming sterile is apparently the six months' rest and the decomposition of the long dry stubble and roots with the setting in of the rains, their manuring properties being worked into the soil by the plough. Without a scientific rotation of crops, such as is understood in Europe, to prevent the exhaustion of the land, Mr. McKerrall thinks it highly probable that these deltaic paddy lands, cropped year after year, without manure of any kind, are slowly but gradually undergoing exhaustion—an assumption favoured by the Burman cultivator's preference for new land situated low enough to secure an efficient water supply, or land adjacent to villages, which is accessible to manurial matter washed down from houses and cattle sheds during the first showers of the monsoon. In fact, the Deputy Director of Agriculture considers there is good reason to suppose that future investigations on experimental farms will prove that the delta paddy soils

will be quite as responsive to manurial treatment as soils in general are.

Cultivation Begins by Ploughing usually about the last week in May, the implement used being of a very primitive type and more of a harrow than a plough: The first field cultivated is the nursery. This is carefully selected and generally the one in which an early abundant supply of water is obtainable. After the bunds have been carefully repaired and the soil is found to be sufficiently softened, it is ploughed by the *htun*, a Burmese harrow, consisting of a log of wood in which are inserted a varying number of teeth—generally about six—the ground being gone over six to eight times until it is of the consistency of fine mud, and on this the seed paddy is broadcasted at the rate of about one to one and a half baskets or more per acre. Should the soil be too stiff for the harrow to break up, the *hte*, or Burmese plough, is used. This consists of a wooden sole with an iron share and with a handle and a pole for attachment to the yoke of the bullocks; but in the deltaic lands it is only used when the soil is found too stiff. These implements cultivate only to a depth of 3 or 4 inches, it being argued by the natives that the soil is so shallow that deep working implements produce harmful effects. Manure, when used, is only applied to the nursery, and consists of either cowdung or paddy husk in small quantities, about a month before cultivation commences, and is subsequently ploughed.

While the Young Plants are Growing in the nursery, attention is turned to their fields, by which time the monsoons have fairly set in, producing a rank growth of grass and weeds. To get down the latter, the *settun*, an implement drawn by two bullocks, and consisting of a pole of hard tough wood, about 2½ inches in diameter, is used. To this pole are fixed a series of very sharp steel blades which revolve when the machine is dragged by the bullocks and cut down the grass. The grass being got rid of by the *settun*, the *htun* or harrow is then employed to get the ground into suitable condition for the transplants. These are taken out of the nursery about a month after sowing when they are about a foot and a half high.

Transplanting is generally done by women who, taking little clumps of three or four plants, thrust them into the ground at distances of about 6 or 8 inches apart. Recent experiments in Bengal, it is said, seem to prove that one plant per hole gives as good results as four or five, and it is therefore worth ascertaining whether similar results could be obtained in Burma. As a general rule, a paddy nursery, in Lower Burma, is reckoned to plant out from eight to ten times its area. If one plant per hole gives as good results as three or four, it naturally follows that a considerable saving of seed might be effected. From the time the paddy is transplanted, up to about a fortnight or three weeks before it is reaped, the fields are submerged in water. But this water must be got rid of when the grain is ripening, otherwise the proper degree of hardness of grain cannot be obtained, and where this object is not attained by evaporation the surplus water is run off into marginal ditches.

Harvesting begins about November, and goes on to as late as January. Before this commences, and when the crops are ready for reaping men go through the fields and "fell" the standing crop flat to the ground with bamboo poles. As all cutting is done by means of the sickle, this felling in one direction facilitates the work of reaping.

The grain is threshed out, in the primitive way, by bullocks and by hand, threshing machines and winnowers being unknown. The usefulness of such machines is quite unknown to and unrealised by the Burman cultivator.

There are said to be about 120 varieties of paddy in Burma. The greatest demand at present, by the large rice mills, is for those known as *Ngatsein* and *Ngachauk*, the former especially being considered best for export purposes, as a harder grain and better able to stand a voyage without deterioration.

Mr. McKerrall puts down the cost of cultivation, including rent at Rs. 6 per acre, at Rs. 21 per acre, the average yield per acre being taken at 40 baskets. This would bring the cost of production per 100 baskets to Rs. 52·8. Sold at Re. 1 per basket by the cultivator the net profit per acre is Rs. 19. Taking the holdings or farms at an average of about 20 acres this would give a yearly profit to the cultivator

of	Rs. 328
Deducting from this interest on loans from Chetty, say 20 per cent. for 8 months ...	,, 66
leaving as net profit ...	... Rs. 262

or barely Rs. 22 a month for the support of the cultivator and his family.

It can thus be realised how the cultivator fared when, for two years, in 1894

and 1895, the rice combination fixed the price of paddy at Rs. 70 to Rs. 75 per 100 baskets.

The indebtedness of the Burma cultivator, especially in Lower Burma, is, as Mr. McKerrall admits, a striking feature in the economy of the country owing, for the most part, to his being a strong upholder of *pwes* and pagodas and of the maxim *carpe diem*. Nature in Lower Burma being always bountiful, and the crops rarely failing, the cultivator does not believe in putting anything by, since the aphorism, about a reserve for a rainy day, is meaningless to him. Mr. McKerrall sums up his description of the whole cultivation of Lower Burma as careful and good, according to the lights of the people, its weak points being want of care in conserving and applying manure, also the absence of good methods of cleaning, grading and selecting seed to improve the type. An Agricultural College has been established, and it is hoped that these defects will gradually disappear by the college students and experts spreading a knowledge of improved methods.

KOREAN RICE TRADE.

(From the *Indian Trade Journal*, Vol. XIII., No. 158, April 8, 1909.)

We reproduce below from the January number of the United States *Monthly Consular Reports* the greater part of an excellent report upon rice production in Korea. It will interest persons concerned in the Indian trade to notice certain differences of practice and to observe that in the Korean methods of measurement, etc., there is a similarity to those encountered in parts of India. The facts about the proportions of cleaned rice to bulk rice treated and about the marked discrepancies between the prices of rice at various points not greatly distant from each other are worthy of attention. The report is by Consul-General Thomas Sammons, of Seoul, who illustrates the importance and value of the industry both to Korea and to Japan :—

American rice-cleaning machinery is being extensively introduced in Korea and invariably gives the best possible satisfaction. The machines are so constructed that broken or worn out parts can be replaced without difficulty. In construction these machines are simple and the natives readily learn to operate them. The English type of rice-cleaning machinery is not utilized, although a number of Japanese machines are being sold in the Korean market.

An idea of the extent of the rice industry of Korea may be had from estimates of the annual yield, as based partially on the total production in Japan. Japan's yield is placed at approximately 14,800,000,000 pounds and, on a basis of 1 koku of 320 pounds, or 5 bushels to each person, this aggregate would supply more than 46,000,000 people. Assuming that Korea has approximately 10,000,000 population, its annual rice crop would amount to 3,200,000,000 pounds, $6\frac{1}{4}$ per cent. having been exported in 1907. This rough estimate is based on 1 koku to each person, while as a matter of fact many adults may consume more than 5 bushels of rice in a year in Korea. However, it is also true that in northern Korea many natives exist largely or wholly on millet. It is probable, therefore, that the Korean rice crop does not average 1 koku to each person, although it is claimed Koreans consume more rice per capita than either the Japanese or Chinese.

EXPORTS AND IMPORTS.

Of the total rice yield of Korea a considerable quantity is exported to Japan. A small quantity of Korean rice is also exported to China, largely for Japanese consumption in Manchuria. During periods of impaired rice yields Korea has imported large quantities of the cereal; under normal conditions small quantities are imported. In 1907, however, immense quantities of the surplus of the 1906 crops were sold to Japan at unusually high prices. On a total of 199,631,066 pounds of Korean rice exported in 1907, principally to Japan, a custom-house valuation of $3,728,110 was placed, the appraised valuation being approximately $2·50 per picul of 133 pounds. These figures indicate a more extensive rice-export business than the prevailing conditions in Korea warrant.

Very little of the rice that is cleaned with American machinery in Korea is exported. A small amount goes to Dalney (Tairen) and Manchuria, and is there sold, as in Korea, mostly to Japanese residents. The rice that is cleaned with foreign machines is called "white" rice, to distinguish it from the ordinary native cleaned or "brown" rice.

In order to indicate the extent of shrinkage of Korean rice during the cleaning process, it may be said that out of 100 bushels of bulk or unhusked rice, locally termed "paddy" rice, 40 to 50 bushels of "brown" rice may be saved. In further cleaning this "brown" rice the brown cuticle or husk is removed and it thus becomes "white."

It may thereafter be polished at an additional expense, but without this additional polishing process it is ready for the Japanese consumers at from $8 to $9 per koku of five bushels or 320 pounds, as quoted during January, 1908, Out of the 100 bushels referred to upwards of 40 bushels of "white" rice of an excellent quality are obtained. The bushel measure is not used, however, but in measuring unhusked rice the native who can deftly pile on the greatest heaping measure is the man sought after by the purchaser.

Inasmuch as very little "white" rice is exported the bulk of the exports consists of "brown" rice which is to be further cleaned in Japan, and eventually some of the choice Korean rice when highly polished finds its way to the London market. The best Korean rice is noted for its superior qualities and commands exceptionally high prices.

Korean rice culture is carried on almost wholly by hand, and it is not probable that hand methods used in the cultivation of rice in Korea will ever make way for the American seeder, self-binding harvester, or steam thrasher. The Korean farms are all small and the present native product is higher in yield to the acreage than is the American rice. The cheap labour of Korea also permits of methods which the labour conditions in America would render prohibitive.

COST OF CLEANING RICE—PRICES, CLEANED AND UNCLEANED.

The present prices for cleaning rice in Korea vary since the machine mills charge different prices, according to the quality and in regard to the disposition of the bran, broken rice, etc., but it may be said that from 20 to 25 cents gold per koku of 5 bushels is charged at Seoul for cleaning rice sufficiently for the native Korean market. Additional cleaning and polishing nearly double the cost.

During the various processes of cleaning bulk rice shrinks from 20 to 50 per cent. The natives use blocks of wood, in which grooves have been cut, and by a grinding process the outer husk is torn from the rice. If the native wishes to continue the cleaning process a mortar and pestle are used. It is estimated that 50 per cent. of the Korean "white" rice is cleaned in this way. Korean farmers and their families consider their labour of little or no value in cleaning their rice crop during the three months when the country is frozen up.

The price of uncleaned rice in Korea varies every day according to the demand for the many different grades but usually ranges between 90 cents and $1 gold per bushel. Best machine-cleaned rice retails in Korea (January, 1908), at about $1·80 gold per bushel, while that cleaned for Korean use sells at about $1·35 gold per bushel. Korean "white" rice suitable for sale in Japan sells at from $1·60 to $1·80 gold per bushel; but to this must be added transportation charges and a Japanese import duty of 5 per cent. Rice can be delivered in Manchuria, suitable for that market, at from $1·65 to $1·80 gold per bushel.

RICE CROP CONTROLS KOREA'S TRADE.

Although the Korean crop for 1907 was a good one, the peculiar internal conditions affecting the peninsula have delayed the delivery of rice from the farms, and in consequence the entire Korean commerce has been somewhat disturbed. Thus, in January, 1908, a bag of rice valued at $2·25 at a seaport town was selling for 10 per cent. of that price in the interior. Probably in a very few sections of the Occident is the economical condition of affairs so affected by the supply and demand of a foodstuff as in Korea by the annual rice crop.

INFLUENCE OF PRICES IN JAPAN.

The Korean farmer usually turns over half of the crop to the landlord, and in consequence of the non-delivery of a portion of last year's rice the landed class in the peninsula has been affected as well as the poorer people. The landlord pays the taxes in sections where land is in little demand, but in the provinces where the population creates a greater demand for land, the tenant usually pays the taxes. The unhusked rice in either case is usually divided evenly between the landlord and tenant, each party paying for the further cleaning and transportation.

VALUE OF ANNUAL PRODUCTION.

Although the rice crop exerts a powerful influence over the business of Korea, complete statistical data are not available as to acreage, yield, or yearly production, and therefore the following approximate statistics are of both a novel and interesting nature. The recent census of Korea, taken under Japanese police supervision, places the population of the country at 9,781,670. With these figures as a basis, they being considered accurate for all practical purposes, it is possible to ascertain the approximate yearly rice production of the peninsula. Inquiries made among Japanese authorities have resulted in data as to the

average consumption of rice per man, woman, and child, and these figures applied to the Korean population place the approximate rice production of Korea for home consumption at considerably more than 3,200,000,000 pounds, or, roundly, 50,000,000 bushels. To be added to this in estimating the yield are the 100,000,000 pounds, approximately, of native rice annually exported for the last six years, thus bringing the total production up to 3,300,000,000 pounds. Although these figures are approximate they give a fair idea of the probable rice production of Korea. The American rice crop amounted to 377,971,917 pounds in 1905, valued at $12,955,748.

METHODS OF MEASUREMENT.

It is, however, much more difficult to ascertain the rice productive area of Korea. Different measures of capacity obtain in the majority of the provinces, and the Korean farmers measure their fields by so many days' "ploughing," or the area covered by a man, an ox, and a wooden plough during one day's work. Naturally a day's "ploughing" differs in extent from one end of the Empire to the other. Not only are the farms measured by the "one day's ploughing" system, but the Koreans also have heretofore sold and transferred land on the basis of the average amount of ground sown by a certain measure. Thus, "one mal (measure) land" is that which can be sown with one such measure of rice seed and "two mal land" is twice as much. Thus it will be seen that rice has not only usually headed the Korean export list, but also established the custom for real estate transactions. Elsewhere in the Far East the influence of rice is greater, if anything, than in Korea, for speculation on the rice exchanges, when the Government does not stop it, constantly changes the price of the staple and affects the entire population. In the olden days the Japanese officials were paid in rice in many instances.

In Korea approximate calculations place the production of an acre of good rice ground under favourable conditions at about 1,700 pounds of the cereal. From these figures it is possible to conservatively place the approximate rice productive area of Korea at 2,941·17 square miles, or a little over 3½ per cent. of the total area.

ACREAGE YIELD IN KOREA, JAPAN, AND AMERICA.

In view of the fact that the Japanese department of commerce and labour places the average rice yield in Japan during the past ten years at 14,148,514,373 pounds and the average imports and exports for a like period at 723,274,903 and 132,832,207 pounds, respectively, the following approximate figures convey an idea of Korea's yield as compared with the area in square miles under cultivation in that country and Japan and the United States:—

	Area, square. miles.	Per cent. of territory.	Yield in Pounds.
Japan ..	11,098·64	7·516	14,787,[illegible]97,732
Korea ...	2,941·17	3·6	3,200,000,000
United States ...	1,699·48	·056	377,971,917

The figures for Japan include the yield in Formosa for 1906. Those for the United States are for 1905 and do not include Alaska or insular possessions. The approximate average yield per acre is estimated as follows: Japan, 1,915·5 pounds, Korea, 1,700 pounds, America (on small tracts), 1,892·2 pounds. In Korea and Japan rice farms are small. Some areas in America, rented to Orientals, produce 2,157·9 pounds per acre, but large farms produce less than half that amount.

KOREAN RICE DISPLACED IN JAPAN.

Although for two years before the Russo-Japanese War Japan began to collect an immense quantity of foreign rice, the Korean market did not supply any large quantity of these stores. For 1903 and 1904 Japan's imports of rice from British India nearly trebled, notwithstanding that the productive area was increasing in Japan at rapid strides. This large import from the south no doubt affected the comparative standing of Korean-Japanese rice trade on paper, but not in reality. In 1906, however, rice began to ascend to its former place at the head of the Korean export list, and consequently nearly doubled over the returns of former years. This can be accounted for by high prices of 1906 in Japan and the withdrawal of the military forces from the peninsula, also by the large quantities of rice held in reserve in Korea at the close of 1905.

The approximate value of Korean export rice in 1907 averaged $2·50 for one picul of 133 pounds.

AMERICAN AND KOREAN RICE-FARMING METHODS.

It may be estimated, on the basis of "one-man plough" or "one day's ploughing," that the Korean farmers sow about 45 pounds of seed rice to the acre of good land. The South-western American farmer, according to the census of 1900, sows about 80 pounds to the acre and secures, on an average, 825 pounds of rice from this area, while the Korean farmer obtains about 1,700 or more pounds from a like field.

The Koreans grow the standard food rice, the glutinous or "cake" variety, and the "Providence" or upland rice. The dry-grown rice is, naturally, of poor quality and little of it is used. The Korean follows the Chinese and Japanese methods of rice culture on about 90 per cent. of the farms of the Peninsula. The American covered and open methods are rarely used in the Orient, but instead the wet-grown rice is sown very thickly in a limited number of paddy fields, or in certain "cheeks" (sections of the paddy field always used for the purpose, between "cheek" walls) called nurseries, and when the plants are about 6 inches high, or about at the American "point flow," and before the head shoots and the grain appears the shoots are plucked up and transplanted. This process of transplanting takes place during June, and the paddies (fields), usually lifeless, are then seen full of busy men and women knee-deep in the water.

SKILL OF CHINESE AND JAPANESE.

The Japanese and Chinese are probably the most skilful rice growers in the world, the former having made a study of the process for many years. The Japanese have, by the skilful use of fertilizers, increased the productive power of their land. The Koreans use wood ash and manure as fertilizers, at times kneading it into the soil of the paddy fields with their hands. The field ("cheek" or "page" of the paddy field, as designated in the vernacular expression) in which the seed rice is grown resembles, shortly after the tender shoots appear, a patch of Kentucky blue grass. This is thinned out and the shoots transplanted over the entire paddy field. The American open and covered methods are at times employed in planting mountain rice. The Japanese method of planting has been tried in America but with doubtful success.

The Japanese sow their rice on the 88th day from the beginning of spring and transplant it in Nyubai, the period fixed for the early summer rains. The 220th day from the beginning of spring is looked upon as a day of special importance to the crops, which are at this time certain to be injured if there is a storm, for the rice is in full bloom. A similar method obtains in Korea, it being the local custom to plant the rice at certain periods of the native calendar and transplant it at others, the times varying in the different provinces of the peninsula.

KOREAN METHOD OF CULTIVATION.

The Korean lowland farmer plants his rice in small paddies, after transplanting, separated by low "cheek banks." He regulates his water carefully at certain times, as does the American rice grower, and weeds at stated periods. The water flow is regulated by intake and spillway flumes or small ditches. Dry rice is also grown, the American open method being used in planting. The harvest is cut in October by hand and stacked to dry. The grain is then beaten from the stalk by hand and sacked, and the tenant then divides with the landlord. The rice is next hulled by being run between wooden toothed rollers operated by hand. The methods of polishing the grain vary. An ingenious water hammer, operated by a bucket on one end of a larger hammer handle that fills with water from the stream and raises the hammer, which falls on the rice when the water runs out through the spillway of the bucket and thus relieves the weight, is sometimes used. It is also polished by a long handled hammer operated by foot power. The women usually polish the rice, or the farmers do it at odd times when they have nothing else to do, so the exact cost of hand-cleaning is not known.

VARIETIES OF KOREAN RICE.

There are several varieties of rice grown in Korea, namely, the glutinous, non-glutinous, and the red or "beer" rice, native beer being made from the latter. As with other Orientals the Korean prefers his native rice to that of foreign growth. There are three main brands of native rice, namely, the ordinary paddy-field rice, the so-called upland rice, and the mountain rice. The paddy-field rice is also known specifically as the "tap-tok" rice and is used almost exclusively to make the ordinary boiled rice or "pap." The so-called upland rice is the "chung-gok" or field rice, and is drier than the paddy-field rice, being used extensively for brewing beer and for making rice flour. The mountain rice is known as "fire-field rice," no doubt because it is grown exclusively on the mountain slopes facing the sun and generally in the southern districts of the country, for the Korean word "wha" or "fire" is the element corresponding with south, so instead of being "south-field rice" it is "fire-field rice" on account of the location or the sunny situation. This rice is much smaller and harder than the other kinds, and is used largely to supply the garrisons, since it withstands the weather better than the other grades and may be stored for years without deterioration.

The enemies of the Korean rice crop are drought, flood, worms, and locusts

The most skilful Korean rice farmers live in the southern districts, which are called by the natives "The Golden Valley of a Boundless Sea of Waving Grain." It is believed rice was introduced into Korea from China, together with other cereals, in 1122 B.C.

A NEW CANE-CUTTING MACHINE.

(From the *Queensland Agricultural Journal*, Vol. XXI., Part 6, Dec., 1908.)

For several years inventors have been at work with the object of producing a machine which will not only cut, but also top, the sugar-cane. None have hitherto been successful. Whatever machine has been, or may be invented for the purpose, it is certain that none will ever work satisfactorily on rough stony land, where, in many cases, the finest cane is grown. Once more an inventor has entered the field, and every one, whether cane-grower, mill-owner, or general farmer, will heartily wish him success. Mr. W. J. Howcroft, of South Brisbane, is the inventor of a machine which, he claims, will prove that he has overcome all the difficulties which previous inventors have been unable to cope with. As soon as the necessary motors arrive from America, a public demonstration will be given, probably at Bunderberg. The invention, which at present is financed by a local syndicate, has been patented in all sugar-growing countries, as well as in Great Britain. Mr. Howcroft supplies the following information concerning his invention :—

Like an ordinary harvester, the machine runs outside the cane, and the motor power sets in action a series of blades, which are aptly termed "feelers" or "fingers" which, when not in use, can be raised to a height of 18 in. above the ground. When working, these "fingers" are lowered, and seize the cane in the same manner as would be done by a man when cutting. Beneath them are cutting knives, rotating on a lever at high speed—some 400 revolutions per minute. These are so arranged that they can cut the cane an inch or more below the surface of the ground, a most important point, as all sugar-growers know. As soon as the canes are cut, they pass on a movable platform to a man who watches till the canes reach the point at which they would be topped by the human cane-cutter. Then the topping knives, which revolve at the same speed as the cutters, top each cane at the right point, after which they are delivered on the ground by means of a trough. The tops themselves are passed out separately. The machine is worked by means of two small oil motors.

Should this machine fulfil its inventor's expectations, the cost of cane-cutting will be so reduced—amounting, it is claimed, to a saving of five-sixths of the present cost—that cane-growers will reap an enormous benefit. The machine is expected to cut 150 tons of cane a day which would mean that a 30-ton crop on 50 acres would be harvested in ten days. This rapid work, if it be accomplished, will be of incalculable benefit to growers and mill-owners where cane has been heavily frosted, as occurred this year. Thousands of tons of cane could have been saved which became either a partial or total loss, owing to the impossibility of getting the frosted cane off in time, seeing that, at the most, smart cane-cutters can only cut about 3 tons a day, even when working—as many cutters do—as long as 10 or 12 hours a day. In 1907, 94,384 acres of cane were crushed out of a total area planted of 126,810 acres. The weight of cane crushed was 1,665,028 tons. Should this machine fulfil the expectations of the inventor, its value to the sugar industry cannot be over-estimated.

TIMBERS.

TREE FELLING.

BY J. C. WILLIS.

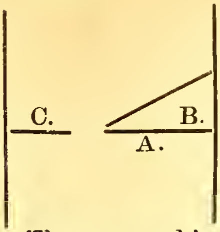
While lately spending a few weeks on Puget Sound (Washington State, U. S. A.) with my brother, I went into the question of tree felling, which is there brought to greater perfection than anywhere else.

As an instance of the speed with which a tree is felled, an Oregon Red Fir, which I measured to be 175 feet high, and 42 inches in diameter at the point where it was cut, was felled by my brother and a neighbour (Mr. Viereck), neither of whom are professional loggers, in *31 minutes*. The wood of the red fir is harder than say that of the Katu-imbul (Bombax) or most of our quick-growing leguminous trees.

Not only so, but the tree is felled in a direction which is determined before a

cut is made, so that it can be brought down with the least possible damage to itself or other trees, &c. My brother stuck a stake in the ground 50 feet from the tree, and bet me 10 dollars that the tree would strike it, and it did. They tell a story on the coast of a newly-arrived tenderfoot from England who started to fell a tree by hacking at it all round, as is often seen here in Ceylon. He was asked in what direction it was going to fall, and replied " Do you think I'm a blooming prophet?"

The method employed is simple. First, with the cross-cut saw a cut is made as marked A on the sketch. Then with axes the wedge B is cut out, and finally the cut C is made with the saw. The wedge is cut out with a flat upper side, so that it looks like the lid of a half opened box, and the tree then falls exactly upon A.



The axe used is of course not the axe known here as American, but the double bitted axe, with a blade on either side of the head, which has completely superseded all others.

PLANT SANITATION.

ENTOMOLOGICAL NOTES.

BY E. ERNEST GREEN,
Government Entomologist.

"GREEN BUG" ON TEA.

Attention was drawn, in the February number of this Journal, to the prevalence of 'Green Bug' (*Lecanium viride*) on tea in certain districts. I have since had an opportunity of visiting one of the estates upon which the pest was present. The infested bushes could be detected from a considerable distance by reason of the black fungus that always follows the bug, forming a thick deposit upon the leaves. A similar fungus is associated with the presence of 'Brown Bug' (*Lecanium hemisphæricum*), and another bug (*Pulvinaria psidii*) which—in its earlier stages—may readily be mistaken for 'Green Bug.' All of these scale-insects occurred in the same fields. A closer examination of the bushes showed that the insects were present in very large numbers; but the effect upon the apparent health of the trees was remarkably small, considering the virulence of the attack which had (I was informed) been prevalent for over six months. There was no marked fall of leaf. The older leaves were quite blackened by the consequent growth of fungus, but the bushes were otherwise vigorous and were still flushing. Moreover, the yield of tea from the infected fields had been well up to the average. On this estate the bug-infested bushes were white-washed immediately after pruning, and the prunings were burnt. This treatment effectually checked the pest for at least a year. Though the bug usually reappeared after that time, its effects were not felt—to any great extent—during the period remaining before the next pruning. Under these circumstances, I do not consider that any treatment is necessary, except at the time of pruning.

As mentioned in my early report upon 'Green Bug' (in 1886), lime-water or white-wash is very effective in killing every individual that it actually touches. Dry lime is quite useless. It is the caustic action of the wet lime that is needed. White-wash is usually employed, but clear lime-water (if freshly prepared) is equally effective and easier of application. The cost of whitewashing an acre of tea, in a really thorough manner, by means of a brush, is considerable. Lime-water can be applied as a spray. If white-wash is used, the most economical method of applying it would be by means of a pneumatic distributor, such as is employed for painting large buildings.

Soapy insecticides may be employed in place of whitewash. In fact such preparations are recognized as of special importance in the treatment of scale-bugs of all kinds. "The Planters' Chronicle," of February 5th, gives particulars of a wash that has been found useful against 'Green Bug' on coffee in India. It is recommended by Mr. A. G. Nicholson, of Coonoor. The mixture consists of 1 lb. bar soap and 1 lb. refined saltpetre, to a kerosene tinful (4 gallons) of water. Mr. Nicholson uses a brand of soap known as 'Gossage's Mottled Blue Bar,' costing Rs. 15·50 per case. The refined saltpetre costs Rs. 190 per ton. It is stated that the "mixture works out at about 4 to 5 annas per kerosene tinful, according to the cost of carriage to the spot."

Mr. Nicholson apparently applies the mixture with a brush, which must be somewhat costly. I would suggest substituting* "Imperial Bar" soap for the 'Mottled Blue.' Mr. Antram (Entomologist to the Indian Planters' Association) reports that this brand is not only the cheapest in the market, but that it forms a mixture quite free from sediment, so that it can be sprayed through a cyclone nozzle without any difficulty.

THE 'PULVINARIA' BUG.

This species (*Pulvinaria psidii*, Maskell) has been known to occur on tea for many years. But it usually confines its attacks to individual or small groups of bushes. It is allied to the 'Green Bug,' but may be distinguished—in its later stages—by the presence of a conspicuous white ovisac, when it resembles more nearly one of the 'mealy bugs.' In its earlier stages it resembles almost exactly the 'green bug,' the only noticeable difference being that the latter has a curved series of blackish spots on its back. Both species affect the bushes in a similar manner, and the same remedies are applicable in each case.

A 'MEALY BUG' OR *Tephrosia candida*.

I have observed specimens of this plant—now cultivated as a green manure—infested by a mealy-bug (*Phenacoccus iceryoides*). This bug has but recently attracted attention in Ceylon, though I have received it from India, on several occasions. It is one of the largest of its kind and appears to be remarkably prolific. If unchecked, it might develop into a serious pest. The specimens submitted to me were being preyed upon by the carnivorous larvæ of a small butterfly (*Spalgis epius*); but it would not be wise to trust entirely to natural enemies which are uncertain in their action. The pest is a conspicuous one and cannot well be over-looked. The insects congregate upon the stems of the plant, covering them thickly with hemispherical masses of white mealy secretion which conceal innumerable eggs. Affected plants should be cut out and burnt.

THE 'PADDY FLY' (*Leptocorisa acuta*).

Mr. Drieberg sends me a report from one of his Agricultural Instructors, giving particulars of experiments with a sweeping net against Paddy flies (as suggested by Mr. Lefroy). The treatment appears to have been effective, as—after the use of the bag—no more insects could be seen in the field.

Mention is made of two varieties of paddy ('Burma Drought-resisting' and 'Kiushu') that were very severely attacked, and of one variety ('Thillainayakam') that appeared to resist the pest. Such observations are of great importance and should be carefully collected. It may be possible to breed a strain that will combine the resistant properties of 'Thillainayakam' with the more valuable qualities of some other varieties.

It has been suggested that the immunity of 'Thillainayakam' paddy is due to the fact that "this variety has the peculiar tendency of flowering during the midday (at which time the flies take shelter at the bottom of the stalks) and of closing up by 2-30 or 3 p.m., before the flies come up." This explanation requires corroboration, firstly, as to the statement that the flies take shelter at midday; and, secondly, as to whether this opening and closing process is continued each day during the ripening of the crop. Damage to the grain does not usually occur at the time of flowering, but later, when the grain has begun to form and while it is still soft and milky.

A BLOOD-SUCKING BUG.

A correspondent has sent me specimens of an evil-looking bug which had been gorging itself at his expense. It is quite distinct from the notorious 'B-flat' (or bed-bug—*Cimex lectularius*), though it has acquired the same objectionable tastes and habits. The examples first received were small and immature, but their bodies were fully distended with blood. My correspondent reports that he was disturbed at night by the bites of these creatures and found several of them crawling about the bed. The consequent irritation was severe. Subsequently the adult insect (probably the parent of the troublesome brood) was discovered in the same situation. It proves to be a Reduviid bug (*Conorhinus rubrofasciatus*), an insect of quite formidable size, measuring over an inch in length.

Bugs of this family normally prey upon other insects; but several species of *Conorhinus* have gained an evil reputation as systemtic blood suckers. *C. sanguisugus* is a troublesome domestic pest in parts of the Unitsd States. Darwin, in his 'Voyage of the Beagle,' describes a species of *Conorhinus* that attacks travellers when camping out on the Pampas of South America. As far as I know, the present record is the first

* Since writing the above I have been informed that "in some instances 'Gossages' Blue bar' is cheaper, because of the heavy cost of transporting 'Imperial' from Calcutta to, say, the Nilgiris."

of the kind from Ceylon. The insects frequent outhouses, hiding amongst the rafters during the daytime and sallying out to feed at night.

THE COLOMBO LAKE FLY.

I have at last received the scientific name of the notorious 'Lake Fly.' It can now be definitely labelled as *Chironomus ceylanicus.* I fear, however, that this knowledge will not appreciably mitigate the inconvenience occasioned by the pest.

WILT DISEASE OF PEPPER.

(Summarised by T. PETCH.)

The wilt disease of pepper first began to attract attention in Southern India about ten years ago. During the next four or five years it caused considerable loss both on European and native plantations, and consequently was the subject of investigation, first by Barber and afterwards by Butler. According to butler's report, "over four thousand acres of pepper cultivation are in the hands of Europeans in South Wynaad, and perhaps five times as many are grown by natives. A far greater amount is grown on the coast districts of Malabar, but it is impossible to estimate how much this may be." By 1904 some estates had already lost the greater part of their plants, and others were affected more or less severely. About the same time, a disease with the same symptoms was discovered in Java where it was investigated by Zimmermann and Breda de Haan.

This disease was discovered in Ceylon in 1906, and was recorded in the Report of the Mycologist for that year. Since then, specimens have been received from time to time, but no widespread damage has been recorded. Pepper in Ceylon, although a paying crop in some districts, is only a subsidiary one, and there are no extensive areas under pepper cultivation only. It is usually grown among cacao or tea, and under these circumstances it is probable that the spread of the disease is restricted. There are small blocks of pepper alone on some estates, and these suffer more from the disease than the vines scattered through cacao.

The symptoms are described by Butler as follows:—"In a healthy full-grown vine the trunk of the standard is entirely hidden in a mass of foliage. This arises from a number of climbing stems which closely embrace the standard and secure themselves to it by numerous tufts of ærial lateral roots. When such a vine becomes diseased, the first symptom noticed is an appearance which was described to me as a 'staring' look about the vine. This is due to a loss of rigidity in the leaves and leaf stalks, resulting in their drooping. With the collapse of the leaves the dense covering of foliage becomes diminished, and the stalks of the vine and patches of the trunk of the standard come into view. The next noticeable thing is that a portion of the climbing stems fall away from the standard, as a result of the death of the clinging roots and consequent relaxation of their grip. Soon the leaves begin to turn yellow, and numbers of them are shed. Later all the vine withers, and the standard remains lightly festooned with dead relaxed stalks bearing a few dried leaves. While the upper part of the vine makes no attempt at recovery, the lower part often retain sufficient vitality to form new leaves, or even to throw out fresh shoots. But these in turn succumb, and I have not come across any case of recovery once the leaf-dropping has commenced."

The cause of the disease has not yet been fully determined. In Java, it was attributed to the common eel worm, *Heterodera radicicola*, which was not however thought to kill the vines directly, but to weaken the root system and cause galls through which other organisms could enter the plant. This eelworm is quite common, and it is not surprising that it should occur in the mounds which are built up round the base of the vine in Southern India. But it is not invariably found associated with dead and dying vines, and therefore it cannot be regarded as the cause of the disease in all cases, if in any. If the disease were caused by eel worms, the injection of carbon disulphide into the soil would probably be an effective remedy.

When the vine is dead, the minute red fructifications of a *Nectria* may sometimes be found on the bark. Butler found *Nectria* in large numbers on dead vines in the Wynaad, but as no description has been published, it is doubtful whether the Indian form is identical with that found in Ceylon. A mycelium, presumably that of the *Nectria* referred to, is found in the vessels of dying vines. Butler regards this *Nectria* as the cause of the disease, death resulting from the obstruction of the water supply by the mycelium in the vessels and the gum-formation which its presence induces,

An experimental pepper farm has been opened in Malabar for the study of different varieties of pepper and for the

investigation of this disease. It is hoped to obtain resistant varieties, but as the plant is a slow growing perennial, results cannot be expected for a long time.

Investigations have recently been begun by Messrs. Macrae and Anstead, and in a preliminary paper in the "Planters' Chronicle," the latter recommends the adoption of following measures, pending the results of experiments which are now being instituted.

"In the first place pepper cultivations should be well drained so as to keep the bases of the vines free from stagnant water. A system of drains, 18 inches deep, will probably be found beneficial.

"As a preventative, every vine, healthy or diseased, should be sprayed at least once a year with Bordeaux mixture. The bottom three or four feet of the stem should be well drenched with the mixture. This will require about a quart of the mixture for each vine, and it may be applied with a watering can, though it will be found more economical and rapid to spray it on with a Deming Success Knapsack sprayer fitted with a Bordeaux mixture nozzle.

"As soon as ever a vine begins to show signs of the disease, the area covered by the roots should be given an application of slacked lime, at the rate of about 4 lbs. per vine, broadcasted on the surface, and a trench should be dug round it to a depth of about 2 feet, the soil taken from the trench being thrown inside to cover the lime.

"Care should be taken about forking round the vines; if done at all it must be done very lightly so as not to wound the roots and form points of entry for fungus spores. Cattle manure should be applied as a mulch, and covered down with leaves, etc. At the Taliparamba farm leaf-mould is found to be a good fertiliser for pepper. At all times the vines should be kept heavily mulched, and if this is done no forking will be necessary beyond perhaps breaking up the area just beyond the root spread every year, *i.e.*, forking a circle round the vine outside the range of the roots.

"More care might be taken, I think, with advantage to keep the fields clean. I have already alluded to the importance of destroying dead vines; all diseased plants should be cleaned up and burnt. On one occasion part of a dead vine covered with fungus fructifications was picked up by the roadside, it having evidently been used to tie up a bundle of wood. This serves to show how careful one should be to keep the totes clean, and how easy it is to spread the disease about,"

Mr. Macrae states: "I have been assured that after a diseased stem and the upper parts of the roots to a depth of about one foot have been removed, new cuttings may be planted immediately, and that the percentage of these cuttings that strike is not less than that in places which had not previously supported diseased vines. I was shown such that were five years old and still look healthy. But the reverse is the case in some other instances."

It would seem preferable to leave the ground vacant, after forking in lime, for about a year.

CANKER OF CACAO.

BY A. E. DE JONGE.

[*Recueil des Travaux botaniques Neerlandais.*, Vol. VI, 1909.]

This disease had been observed in Surinam for years. In 1891 it was noticed at Dordrecht and since then on several other estates, but up to the present it has only been sporadic. In the summer of 1907, however, the canker became epidemic on some estates in the Saramacca district. In consequence, an investigation into the disease was undertaken, the results of which are recorded here.

Cankered trees are first recognized by the occurrence of moist patches on the bark, caused by a liquid oozing out, sometimes in considerable quantities. Where it has dried on the bark, this assumes a rusty colour. These places are nearly always found on the trunk and thicker branches; sometimes the younger branches of a tree also show them. When the bark is cut off superficially, it appears to have assumed a claret colour; this claret patch is surrounded by a narrow black border which marks it off sharply from the surrounding healthy tissue which is of a yellowish red colour. These patches occur in large numbers on the tree; they may extend over a large area or even encompass the stem or branch. Often two patches unite into a single one, or one first appears under the surface and joins itself on to another, in the latter case the infection must have spread from within to the outside. Even in badly affected trees, spots which may penetrate to the wood are not always a deep claret colour, but often light red. When these light-coloured patches are exposed to the air after cutting, they become dark red. Where the wood is also affected, it sometimes assumes a red, but generally a blackish brown colour, which may penetrate into the wood for some centimetres. The dark discolouration of

the wood is sometimes continued in narrow stripes far under the healthy bark.

How long the canker takes to kill a tree I cannot say with certainty. It is probable that no more than a few months is required, for in July many trees were found dead, which partly at least had most likely only been affected in the rainy season, but further observation on this point is necessary.

Diseased trees may also be recognized by their foliage becoming thinner, probably when they have been diseased for a long time and are slowly decaying, while dead trees which still bear their leaves probably suffered a severe attack at once and were soon killed.

All these symptoms quite correspond with those of the disease known in Ceylon and elsewhere as "canker," so that it is doubtless the same disease we have to deal with here.

In Ceylon, the canker became widespread in 1896, but had been occurring there for some years before. Not until 1898 was it more carefully studied by Carruthers, who in some reports recorded the results of his investigations; these were written during his investigations and so bear a preliminary character; a more detailed account has, however, never appeared, so that several points, especially in respect to the cause of the disease, have not been fully elucidated.

According to Carruthers it is not only the stem and branches of the cacao trees which are attacked, but the fruits as well. In the diseased tissues he found the mycelium of a fungus, and on the bark the perithecia of a *Nectria*, which he regarded as the cause of the disease.

In the West Indies the canker was first noticed by Hart in Trinidad. Some material of diseased trees was forwarded to Massee, who detected a *Nectria* on it. In 1901 Howard found the disease to be rather common in Grenada and Dominica. A *Nectria* and a *Calonectria* were recorded from the affected trees. According to Stockdale the canker in the West Indies is now met with in Trinidad, Grenada, Dominica, St. Lucia and St. Vincent. In Java it is also known. On one estate Zehntner found the fructification of the canker-fungus (probably *Nectria*).

Finally in 1907 von Faber noticed the disease in the Cameroons, where, up till now, it has not caused much damage. There, also, a *Nectria* has been found on the diseased bark.

On microscopical examination every red spot of the diseased bark appears to be surrounded by a corkcambium, several rows of cells thick. The colour is the result of a red coloured mass in the cells. The discolouration does not always spread. Often a new healthy tissue forms under the diseased area, in which case the red bark is loosened from its surroundings, dries up, becomes dull brown and may easily be removed. Howard noticed this in Grenada, but only in rare cases and when the wood had not yet been affected. Carruthers often saw the moist claret-coloured tissue dry up, after which it had quite the appearance of dead wood. In his second report he says that after having been superficially shaved and exposed to the air, the diseased tissue dries up and "in some cases scales out and drops away, while the remainder of the bark being relieved from its enemy, forms a healthy callus round the injury, and in course of time completely covers over the shaved part." Though the facts mentioned are the same as those observed here in Surinam, this description of Carruthers is not quite correct, for the callus is formed first, and by its agency the diseased patch is loosened.

In the discoloured parts of bark and wood I found the mycelium of a fungus. It sometimes is very scarce, at other times it is found without the least difficulty. It may be especially abundant in the youngest part of the wood. Most investigators have also found the mycelium outside of the discoloured patches; I have not been able to find it there myself. When present in any quantity Carruthers saw the mycelium running in the wood as thin black strands. Like v. Faber, I am unable to confirm this statement.

In order to make a closer study of the fungus it had to be grown artificially. With a sterile knife small pieces were cut from the wood at the borders of the diseased and the healthy tissues. These were transferred to a culture-medium in a sterilized dish. In a few days the mycelium came forth from these pieces as a pure culture. In this way the parasite could always be easily obtained. Soon a conidial fructification developed; on a septate mycelium appear branched conidiophores, from which oval unicellular conidia are cut off.

I consider the fungus as belonging to the genus *Spicaria*. Very characteristic of this *Spicaria* is its property of imparting a red colour to some culture-media.

In the course of my investigations I found another fructification in a two-

months old culture on cacao-bark, namely, pustules of *Fusarium* conidia.

Hanging drop-cultures of these *Fusarium* conidia were started, so that the development could be watched under the microscope. In water no conidia were produced, but a saccharose-solution of ½ % appeared to be suitable. In it the *Fusarium* conidia always gave rise to a mycelium which produced conidiophores of *Spicaria*.

The converse question now arose, namely, whether *Spicaria* could produce *Fusarium*. To study this, I made hanging drop cultures of *Spicaria*-conidia. These nearly always developed a mycelium which produced the *Spicaria*-fructification, but in rare cases the mycelium formed a conidiophore with *Fusarium* conidia.

In several ways I tried to obtain a higher fructification; I made cultures in large flasks and dishes on sterilized bark, wood, bread, or liquids; I let some grow very old, put others into the light or kept them in the dark, but without any success. In old cultures on cacao-bark I sometimes did find small hollow bodies, from which, when pressed, numerous oil drops escaped. As several species of *Nectria* possess two kinds of conidia, microconidia and a *Fusarium*, I do not think it unlikely, that in this case, too, the higher fructification will prove to be *Nectria*, of which the little globules perhaps form the first development.

I have named the species *Spicaria colorans*.

I have not succeeded in producing canker in cacao trees by inoculating them with *Spicaria*. I introduced small pieces of sterilized bark or wood, which had been permeated by the fungus, into small wounds, which had been cut in the bark of the trees, or between bark and wood, and kept these places moist; I experimented in the same way with conidia of *Spicaria* or of *Fusarium*. Nor was infection induced by bringing conidia of *Spicaria* or *Fusarium* on uninjured bark. Experiments in which pieces of diseased bark were introduced into wounds of healthy trees likewise failed. This failure accordingly does not prove anything against *Spicaria* being the canker parasite, but leads to the conclusion, that the conditions which rendered the trees susceptible to the disease, or which are necessary for securing the infection, were not present. Attempts to infect fruits likewise failed.

After this discussion upon the canker parasite I think it advisable to deal with some saprophytes, one of which at least very often occurs on canker trees. It is a *Nectria* which I at first supposed to be the cause of the disease, the more so as in Ceylon and elsewhere a *Nectria* is regarded as such. Moreover, nearly always the same form occurred. It was therefore grown in pure cultures. The bicellular spores were sown in hanging drops; they germinated readily and produced a mycelium with *Fusarium*-conidia. A comparison of this *Fusarium* with the one produced by *Spicaria* makes it clear at once, that it is a form differing from the above described parasite.

1. The shape is different in several respects :—
   (*a*) *Fusarium* from *Spicaria* is more curved than the one from *Nectria*.
   (*b*) the ends of the former are rather sharply pointed, those of the latter always very obtuse;
   (*c*) the former alone often bears a small stalk which is sometimes bent at the place where it was formerly joined;
   (*d*) the contents of the former are much more coarsely granulated than those of the latter.
   (*e*) moreover the dimensions of the former are smaller;
2. *Fusarium*-conidia which originate from *Spicaria*, always produce *Spicaria*; *Fusarium*-conidia from *Nectria* on the other hand never yield anything else than *Fusarium*.
3. Their different character is also shown by their mode of growth on nutrient media. On a slightly alkaline medium, colonies developed from *Spicaria*-Fusarium assume a red colour, those from *Nectria*-Fusarium do not. It is evident from the differences enumerated that this *Nectria* is not a fructification of *Spicaria*, the canker parasite.

Probably we have to do with *Nectria striatospora*, Zimmermann, which was found by Zimmermann on cacao trees at Buitenzorg, and which he also considered as probably harmless.

As has already been said, *Nectria* is considered to be the cause of Canker in all countries where the disease has been observed.

On a number of diseased patches Carruthers found pustules of small, oval, unicellular conidia; after some time larger, multiseptate, crescent-shaped conidia appeared, and at last perithecia of *Nectria*. From this he concludes that *Nectria* is the canker parasite, and that both forms of conidia are stages in its life-history. This conclusion, how-

ever, would only be warranted if he had grown the fungus in pure cultures, and there seen one form develop from another. As far as can be determined from his publications, he has not done so.

It is true that Carruthers records a series of infection experiments, where in many cases he produced the disease in stems as well as in pods by inoculating them with one of the three kinds of reproductive organs. But since these inoculations were not made with pure cultures, and since the experiments were conducted on estates on which the disease was prevalent, while no control plants were kept (trees treated in exactly the same way as the inoculated ones, except that no fungus was introduced), these results are not so convincing as to remove the doubt which yet remains on many questions. We may consider some of these questionable points. It is possible that Carruthers introduced into the wounds other conidia besides those he meant to use, as he himself refers to the difficulty of growing the fungus in pure cultures on account of bacteria and fungi.

Of the *Nectria* perithecia he says:—"They are to be found only on dead wood or dead patches of dying branches and stems."

Moreover, Petch says: "The *Nectria* on the stem agrees with *Nectria striatospora*, Zimm. It is perhaps the commonest Ceylon *Nectria*, and has been found on tea killed by *Massaria theicola*, tea with branch canker, felled *Albizzia*, etc."

Both these statements make it very likely that this *Nectria* was not a parasite, but a saprophyte.

Whereas Carruthers believed the form found by him to be *Nectria ditissima*, Tul., according to Petch the perithecia on the bark bear a close resemblance to *Nectria striatospora*, Zimm.; numerous examples, collected by Thwaites in the Herbarium, have been named by Berkeley either *N. cinnabarina* or *N. sanguinea*.

The two forms observed by Howard were named by Massce *Nectria theobromæ* and *Calonectria flavida*. The description of *Nectria theobromæ* has just been published. Howard could infect trees by introducing ascospores of both forms into wounds. In the earlier stages of the disease he observed white pustules in the cracks of the diseased bark, consisting of conidiophores bearing unicellular conidia and Fusariumlike, multicellular conidia. Although he thought it highly probable that both conidial forms and the ascus form belonged together, he regarded it as uncertain, until he should have proved it by further investigations which were in progress when his article was published. Apparently he has not completed his research as Stockdale observed recently that an exact knowledge of the life-history of *N. theobromæ* and *Cal. flavida* was not yet complete and investigations would be continued.

The *Nectria* noted by Hart on canker spots of cacao trees appeared also to be *Nectria Theobromæ*. Von Faber also found a *Nectria* on bark from canker trees in the Cameroons. To judge from his figures and description, this form is different from *N. Theobromæ*, and certainly distinct from the one observed as a saprophyte in Surinam. F. Faber had no opportunity of making infection experiments and could only study fixed material, so that he could not cultivate the fungus. Therefore, it is a mere supposition, that this *Nectria* is parasitic on cacao.

From the foregoing it is evident that, although several forms of *Nectria* have been considered to be the higher fructification of the canker fungus, none has been definitely proved to be so by experiments to which no objection can be taken.

We must put another important question which has not yet been solved: What is the cause of the pod-disease?

With conidia, ascospores or pieces of cankered bark, Carruthers could produce the disease in pods. It also spread to the pod from a diseased spot in the bark, and reverted from a pod to the stem. By placing pieces of diseased pods in the bark, canker could be produced in it.

Now in his two first reports Carruthers discusses his observations on diseased pods. The mycelium he found in them was different from that in the stem; in cultures made of them a *Peronospora* developed (in a later report he calls it *Phytophtora*), which also was observed on pods in the field. He therefore made this fungus responsible for the disease. In his third report, however, he came to quite a different conclusion. On further examination he had found the small canker conidia between the large masses of *Peronospora*-(*Phytophtora*-) Sporangia; the first were sometimes found alone but yet nearly always speedily associated with *Peronospora*; hence he supposed that *Peronospora* lived as a saprophyte on the tissues killed by the canker.

In my opinion he is not entitled to this conclusion for the following reasons. The symptoms of the disease on pods, as was also noted by v. Faber, correspond closely to those caused by *Phytophtora;* besides, according to Petch the *Nectria* in cacao pods in Ceylon is not the same as that on the stem. He says: "If the stem and pod-diseases are the same, they cannot be due to *Nectria.*"

Nor is it proved by the observations made in other countries. Howard does not mention a *Nectria* on pods, except the one found by Hart in Trinidad and described by Massee as *Nectria Bainii,* and the pod disease on Ceylon which after Carruthers' reports may be caused by *Nectria* or one of the *Peronosporeæ,* or by both. Nearly all pods, forwarded to Kew on that occasion, appeared to be attacked by *Phytophtora.*

Zehntner speaks of "the rare cases where a canker patch appears at the junction of a pod with the stem and the canker fungus spreads along the stalk to the pod itself." In the Cameroons v. Faber never observed an infection of pods by *Nectria.* Here in Surinam I have never found a *Nectria* as a cause of disease in pods, neither have I seen the canker fungus (*Spicaria-Fusarium*) as a parasite on pods.

From this survey it is evident that Carruthers' infection experiments and the few observations of Zehntner are the only foundations for the belief that canker is a pod-disease; on the contrary, everything seems to show that Carruthers was concerned with the "black rot" (blackening of pods), due to *Phytophtora,* which is known to attack pods in Ceylon, Java, the West Indies, the Cameroons and Surinam, and to cause a great deal of damage in all these countries, except in Java. Petch asserts that in cases where the disease had spread from pod to stem, in sterile chambers *Phytophtora* developed from pieces of bark, peduncle and pod; if this statement should prove to be correct, it would show that *Phytophtora* can attack the stem as well as the pods.

Barrett attributes to one and the same fungus (*Lasiodiplodia*) the "brown rot" of the pods and the canker (red rot) of the stem (as appears from the description of the symptoms). This statement can hardly be correct; it is true, that *Lasiodiplodia* (most probably identical with Howard's *Diplodia* and perhaps with v. Hall's *Chætodiplodia*) does cause the "brown rot" of the pods and also a stem-disease; but this stem-disease is the so-called "die-back," which is quite different from the Ceylon canker, induced by *Spicaria-Fusarium.* I mention this because this mistake may give rise to confusion. For the same reason Barrett's use of the term "canker in its broad sense to include the destruction of woody tissues by any parasitic fungus," is not to be recommended, now that the name canker has already been given to a definite disease.

Carruthers not only tried to combat the disease by treatment of affected trees, but also by removing the conditions which assist in spreading it. As he regarded dampness of the atmosphere as the most dangerous factor on account of the favourable conditions it offers to the fungus, he urged before all things the necessity of removing superfluous shade and of draining the soil, especially in low hollows. Besides this, he advised the planters to burn the dead trees and to bury or burn all discoloured pods in order to destroy the infection-material. As suckers were scarcely ever affected, he recommended not to cut them all in the usual way.

The direct treatment of the trees was to consist in the excising of the discoloured patches with a large margin of the surrounding tissues as the fungus mycelium had been found outside the discolouration, or, if the spots were too large, in superficially shaving them and exposing the parts so treated to the drying effect of the sun. All excised parts were to be burnt.

Meanwhile, Wright had made the experiment of spraying the pods with a mixture of sulphate of copper and lime. As it is however highly probable (as has already been pointed out), that the disease of the pods is not canker, but caused by *Phytophtora,* his favourable results do not teach us anything about the treatment of canker, however important they may be in other directions.

In Java and the West Indies Carruthers' advice is also followed. In the West Indies the wounds are, in addition, treated with tar, as *Nectria* is a wound parasite and the spores should not be given an opportunity of penetrating into the tissues. Carruthers disagreed with the application of tar, as it might prevent the control of the excised spots.

In the West Indies the number of canker cases has also diminished, although the disease has not been eradicated.

In Surinam canker patches are generally excised; after this the wound is left uncovered for some days to

let it dry, and then tarred. A tree often recovers after this, sometimes it does not. As has already been remarked, trees also recovered in many instances without any treatment at all.

Although it is certain that trees can recover without excision of the diseased tissues, we know as yet too little about this to dare trust to it alone. Therefore, the old treatment of carefully looking for diseased spots and excising them, and removing trees killed by the disease, must for the present be recommended as being the safest method.

[There is no doubt that the common pod disease in Ceylon is caused by *Phytophthora*, and that this disease is distinct from the stem canker. But the cause of the latter has not been definitely ascertained. The results quoted by Wright must be attributed to the removal of shade, with some possible assistance from weather conditions, since the estate as a whole was not sprayed until 1905, while his diagram relates to 1902-1904.—T. Petch.]

TERMES GESTROI.

By Walter Towgood.

(From the *Agricultural Bulletin of the Straits and F. M. S.*, Vol. VIII., No. 3, March, 1909.)

In the whole of the past history of tropical agriculture in tea, coffee, cocoa, cinchona and spices, there have been four causes for disappointment and an awakening from the golden dreams with which various enterprizes were originally commenced; *i.e.*

1. Substitutes.
2. Synthetic production at a low cost.
3. Over-production.
4. Pests and Blights.

The first three are beyond the control of the individual, and if any reliance is to be placed on expert opinion the rubber planter in the East has nothing to fear from them in his comparatively new venture, but the fourth, *i.e.*, Pests and Blights, come well within his scope, and it is his duty to leave nothing to chance and do everything within his power to assure the success of the enterprize.

So far we have one blight and one pest which may be considered as serious, *i.e.*, *Fomes semitostus* and *Termes gestroi*.

Fomes semitostus is a blight which, if taken in hand at once and treated according to the advice of the Government Mycologist, Mr. W. J. Gallagher will, I am sure, be easily overcome, as we have successfully dealt with the same class of blight in tea, coffee, etc. by drainage and application of lime.

Termes Gestroi, however, is a very serious pest, and it was in recognition of this fact, that, in my various endeavours to exterminate it, I collected a large number of queen termites; these I showed to Messrs. Carruthers and Pratt, who were much interested, as the queens evidently belonged to two or more species, and it was quite possible the Queen *Gestroi*, which had hitherto never been found, was amongst the collection. This resulted in the investigation by Mr. Pratt, and I have been fortunate in being in possession of the valuable discoveries made by him for a considerable time before they were published. Previous to Mr. Pratt's discoveries with regard to the habits of *T. Gestroi*, I was much afraid that the pest would prove to be a heavy handicap to the Malay Peninsula in its competition with other rubber-producing countries in the future, and a serious though unseen and therefore unrecognized loss, in the present. I am now quite satisfied, however, that it can be altogether eradicated. In my endeavours to exterminate the pest as expeditiously and as cheaply as possible, I have arrived at some conclusions and methods which may be of use to my brother planters.

The following notes refer to flat alluvial land:—

Timbers containing Termitaria of Termes Gestroi.

The determination of these is of the utmost importance and rests largely with planters themselves. In different localities the trees affected may vary, and if planters were to publish either in the Agricultural Bulletin or in the local papers the names of trees and their localities in which the termitaria of *T. Gestroi* have been found, they will be performing a great service to the rubber industry in Malaya. So far, in this particular locality, *i.e.*, North Bank of the Selangor River, I have found the termitaria exclusively in Kumpas and Meranti logs and roots, but chiefly in Kumpas; this, I think, is due to the fact that about two-thirds of the planted area consists of reclaimed land in which Kumpas, owing to its great hardness and durability, is practically the only timber left to deal with.

Both Kumpas and Meranti appear to grow in greater abundance in land at all inclined to be peaty, and this no doubt is the reason for the opinion of some planters that peaty soils encourage *T. Gestroi*, as mentioned in Mr. Pratt's note.

Nature of Soils as affecting the abundance of T. Gestroi.

In view of the fact that the termitaria are contained invariably if not exclusively in timber, it may be concluded that soils only indirectly affect the abundance of *T. Gestroi*, *i.e.*, certain soils are favourable to the growth of trees affected by *T. Gestroi.*

The scils may affect the extent of the attack on rubber trees by being more or less easy of penetration when the termites go abroad in search of food.

Methods of Extermination.

On Old Rubber Trees.—It has to be determined whether *T. Gestroi* establish their termitaria in the rubber trees themselves, and on this point I have no data. If it should prove to be the case, fortunate is he who discovers an insecticide, or other means, by which the Queen cells may be reached, at a low cost and without destroying the tree, and thereby obtain the reward now being offered. On the other hand, our success in exterminating the pest depends upon the skill with which the runs are traced up to their base. If all timber is collected and destroyed I feel convinced that if the attack does not entirely cease it will be very much diminished.

On Young Rubber Estates.—I have found it cheapest and best to make a systematic search field by field and line by line for all timber which is known to be favoured by *T. Gestroi*, cut them open with an axe or cross-cut saw, and if they contain the slightest trace of the enemy destroy them by burning.

The danger of scorching the surrounding plants may be entirely done away with, or at least greatly minimized by burning in a trench, keeping the fire covered with green stuff, and shielding the surrounding trees with sheets of corrugated iron.

These should not lean against the rubber trees but be supported by sticks a short distance from them ; even if two or three rubber trees are destroyed by fire in this way, the damage done is more than compensated for, by the fact that one *T. Gestroi* termitarium is capable of destroying a score or more of trees to a distance of two or three hundred feet.

Where there is a sale for timber or charcoal, sound Meranti trees may be sawn up with advantage and Kumpas can be converted into first-class charcoal.

A close watch should always be kept on land that has been cleared of timber, and if a tree is seen to be attacked, every endeavour should be made to discover the source of infection, which will invariably be found to be a buried root or stump, from which the termites make their way in search of food by means of tunnels. These may be found at a depth of 6″ to 3′ below the surface of the ground. In flat land I have never found them below the subsoil water level, which, of course, is regulated by the efficiency of the drainage system.

These tunnels are, as a rule (as Mr. Pratt says) sufficiently large to admit the introduction of an ordinary microscope slide, though sometimes smaller, they are perfectly smooth and are lined with a red substance, probably the excreta of the termites which takes its colour from the timber on which they have been feeding. This colouring greatly facilitates the following up of the tunnels, but it is by no means an easy matter until the coolies become practised at it, and see for themselves that they are doing real good and not merely following out some mad scheme of their masters. When the direction of a tunnel is lost it is very difficult to pick it up again. I have found the surest means of not losing it, is to use a piece of thin flexible wire or strip of cane as a probe. Pass it into the tunnel as far as it will go, remove the top soil carefully with a chunkol, then break open the run to the end of the probe. Pass the probe in again and proceed as before until the termitarium is reached. To find the tunnel or to pick it up again should it be lost, I have found it a good plan to cut a trench round the tree attacked or the spot where the run was lost. This trench should be to the depth of the water level, say two feet, and should be examined the next day when it will often be found that the termites have made their way across by means of a mud casing, thus determining the direction of attack.

It is a tedious matter at the best to follow up these tunnels, and it is on this account that I have found it expedient to examine all timber which I know to be likely to contain termitaria before resorting to this means, thereby saving much time and expense.

At first I gave rewards for the Queens, and have collected in this way upwards of seventy undoubted specimens, but I find that by this method the coolies waste much of their time in breaking up every smaller piece of the termitaria in order to find the Queen cells.

When a log or root containing the termitarium has been discovered and destroyed, and the ground around it dug up, it may safely be concluded that the

Queen has perished with the rest of the individuals. Usually it is only necessary to trace up the runs in the case of a nest occurring in a buried stump or root.

The first field I systematically cleared of all timber five months ago has since shown no sign of the pest. This field was planted with Rambong about six years ago, it was allowed to lapse into bluker and was interplanted with para in 1906. The only remaining timber was Kumpas, of which there was a considerable quantity. The attack on both Para and Rambong trees was particularly virulent in this block but has now entirely ceased.

As Mr. Pratt very truly says, owing to the cryptic habits of termites, it is very difficult to determine when a tree is attacked until it falls down, but during the wet seasons in October, November, December, and January the termites frequently make their appearance above ground, and this fact, I think, should be taken advantage of, by marking in some way all the trees on which the termites make their appearance, for even if they cannot be attended to at once, one would at least know where to look for them in the future.

I am afraid that some planters are lulled into a sense of security by the fact that none of their young trees have been attacked; it would be well worth their while to make a search for *T. Gestroi* in the timber lying in clearings, and if found, take steps to eradicate the pest, for although trees may not be attacked now, or perhaps for a year or two to come, they will be attacked sooner or later if *T. Gestroi* is present.

I have not found a single tree attacked so far in my forest clearings, but I know that *T. Gestroi* is present. On the other hand in reclaimed land, where owing to the decay of most of the timber, *T. Gestroi* has wandered forth in search of fresh fields and pasture new, and has made its presence evident by attacking young rubber trees.

On Future Clearings.—In these again the importance of discovering the forest trees most favoured by *T. Gestroi* is evident. I cannot speak from practical experience, but the obvious course to pursue would be to cut down all trees known to harbour *T. Gestroi*, and allow them to dry for as long a period as possible, prior to the felling of the land. Many of these trees would be then destroyed in the burn, and those which remained could be burnt out by piling over them the surrounding timber. This would of course enhance the cost of clearing perhaps by \$10 or even \$20 per acre, a small consideration in comparison to the damage that may be effected by *T. Gestroi.*

Further advantages of more thorough clearing would be less likelihood of vacancies caused by *Fomes semitostus* and a saving in the cost of weeding, in fact of every other work carried on in the clearing, together with easier and consequently more efficient a supervision.

COST OF ERADICATION BY DESTRUCTION OF TIMBER CONTAINING TERMITARIA.

It is obviously impossible to give even approximate figures with regard to cost; this depends entirely on the quantity of timber to be removed. One ten acre block may contain a dozen large Kumpas and Meranti trees, and the adjoining fifty acres may contain only half a dozen. The cost may vary from \$2 to \$20 per acre, and it will be necessary to estimate for each ten or twenty acre block separately.

In opening new clearings it is false economy to cut down expenditure on clearing, and it will obviously be far cheaper to eradicate *T. Gestroi* in clearings before they are planted, than afterwards, to say nothing of the saving in the cost of other works and the satisfaction of knowing that the only two pests which we have to fear have been eradicated.

T. Gestroi is frequently found in nibong palms, but owing to the facility with which these can be split up and the many uses they can be put to they do not cause any serious trouble or expense.

Drains as affecting Termes Gestroi.—I have not in a single instance found the runs of termites crossing a subsoil drain, excepting by means of a fallen log or wooden bridge; it follows, therefore, that the more frequent the drains, the more circumscribed will be the attack of the termites, provided that iron or concrete bridges are used instead of wooden ones, and that all timber lying across drains be removed.

The mound termites, *T. Malayanus*, and *T. carbonarius* seem to prefer the edge of a drain for the construction of their termitaria, but *Gestroi* apparently considers the suitability of timber only and not that of soil in choosing its home.

When nearing a drain the *T. Gestroi* runs are usually found at a greater depth than elsewhere; this is no doubt due to the facility with which the termites are able to penetrate the soil which has become freer owing to good drainage.

Importance of Distinguishing the Various Termites.

Mr. Pratt mentions that *T. pallidus* occupies the disused termitaria of *T. Malayanus* and *T. carbonarius*. I have since found that they also occupy the termitaria of *T. Gestroi,* and have had several queens brought to me for reward; these were contained in timber and surrounded by unmistakable individuals of *T. pallidus.*

On one occasion the coolies were following up *T. Gestroi* under my personal supervision when they came on a small piece of timber, two feet below the surface of the ground, it was about one foot in length and four inches in diameter and contained the Queen and myriads of individuals of *T. pallidus* as well as many soldiers and workers of *T. Gestroi.*

I have found *T. Gestroi* in close association with *T. Malayanus* and *T. carbonarius* as well as *T. pallidus,* but there is no difficulty in distinguishing one from the other by their soldiers; there is also a wide difference in the general appearance of the Queens though a great similarity in the workers.

Mr. Pratt gives us the difference of the various termites as far as possible on page 3 of his notes, but I think it would be of more practical value to planters if specimen cases of the termites, showing the individuals separately, were exhibited in some convenient and central spot.

Insecticides for the Eradication of Termes Gestroi.

To anyone who has followed up a *T. Gestroi* tunnel, ramifying as it does sometimes for hundreds of feet, or has seen the interior of a termitarium with its myriads of individuals, the utter futility of attempting to eradicate the pest by means of insecticides must be apparent, but insecticides will be found useful in killing the comparatively few individuals which continue their attack for some time after their termitarium is destroyed. I see that the custom of applying lime to the tree attacked still continues on some estates. This is utterly useless as a preventative, or even as a means of keeping the termites in check; but it is useful as a means of marking the trees attacked.

Crotalaria and Green Manures as affecting T. Gestroi.

Crotalaria is undoubtedly of great advantage as a green manure, but it has yet to be proved if it is a means of cheapening the cost of weeding. There are two objections to it which can however be overcome.

Firstly, the difficulty which is experienced in eradicating *T. Gestroi* and *Fomes semitostus,* will be enormously increased by the fact that all timber is hidden by growth, rendering it necessary to closely inspect each rubber tree and to search about amongst the crotalaria for timber containing *T. Gestroi.* This can be overcome by first eradicating the pest and then planting green manure. Secondly, when the green manure is eventually killed out by shade, the rubber trees will experience a shock from their customary supply of nitrogen being cut off. This can be obviated by interplanting with leguminous trees, such as *Albizzia moluccana.* These trees, together with others of the leguminosæ, have been grown with great benefit to tea and coffee in Ceylon and elsewhere for at least twenty-five years, such growths as *Crotalaria, Mimosa,* etc., being utterly unsuited to this class of cultivation.

In conclusion, there are no grounds for the alarmist's view of the *T. Gestroi* pest though it is imperative that it should be taken in hand at once and dealt with very thoroughly, and although the initial cost may be heavy, it will be more than justified by the subsequent saving in expenditure, on keeping the pest in check, to say nothing of the saving in loss of trees.

HORTICULTURE.

THE ORANGE AND HOW TO GROW IT.

By P. Geo. Schrader.

A good orange is to a great extent a luxury in Ceylon, the reason being that no systematic propagation, planting, and cultivation is carried on. A villager has a few seeding trees growing in his compound. If they bear, the fruit is carried round for sale, and it is nothing uncommon to be asked to pay 10 or 12 cents for an orange—the usual price in Colombo being from 4 to 8 cents. I do not maintain that large orange groves would pay, although if first-class oranges can be grown they would always command a good price in the London market, but still, there is room for a vast

deal of improvement in the growing of oranges in Ceylon; and I also think that if better varieties were propagated and grown in a systematic manner, they would return good interest on the outlay, even if sold at a reasonable price. I have grown the Washington navel orange, and the Sicilian lemon in Ceylon, the plants being imported from Australia, and it is pleasing to note that they are bearing heavy crops.

Propagation.

The seeds from thoroughly ripe oranges should be taken and planted in a bed, well prepared and enriched by adding and mixing with the soil some well decomposed farm-yard manure. If the land is of a clayey nature some sand should be mixed with it to make it free. The seeds should be planted an inch deep and covered over with some loamy soil, and a thin layer of fine manure applied on top to act as mulch. Watering should be done daily, by means of a watering can, a light watering will suffice at this period. Once the seeds begin to burst they should be protected overhead by a light covering; a few unweaved coconut leaves put on top of a light frame work would answer the purpose. The covering should be of sufficient density to prevent the fierce rays of the sun playing on the tender plants, which should never be allowed to become dry, as it must be remembered that any young plant checked in its growing period will never turn out a healthy strong tree. Once the plants have established themselves watering every other day will be sufficient. If the plants have grown well, they will at the end of the first year be from 10 to 12 inches high. They must now be put out in nursery form, that is one foot apart in the rows by 3 feet the other way. They had best remain in the nursery for another year. Weeding should be carefully done, and the soil well worked so as to allow the young roots free access into the soil to collect all the plant food they require. Watering now and again will be beneficial. The time when watering is necessary can easily be ascertained by digging in the middle of the rows which will at once show the state the soil is in.

The usual ways of reproducing plants of a known kind is by budding and grafting, I myself prefer budding to grafting. I will at a future time go fully into the question of budding, so, it will suffice here to say that for budding orange trees buds should be taken from a tree which has borne good fruit. Buds too near the base of the scion must not be used as they generally do not make good vigorous trees, and sometimes they prove barren.

Preparing the Soil for Planting.

A great deal of attention should be paid to preparing the land for receiving the young trees. The soil should be trenched to a depth of 18 inches, which is easily done by digging a foot wide and 9 inches deep, and throwing the soil away from the land. The remaining 9 inches of bottom soil is then dug up, then another one foot wide by 9 inches deep of surface soil is dug up and thrown into the trench, and so on till finished, when it will be found that 9 × 12 inches of soil is necessary, to which is carted the soil originally thrown out. If good ploughs are available sub-soiling by their means is the easiest and cheapest—one plough follows the other, the second plough having its mold board removed. If this work is done a few months before planting so much the better, as it allows a free access of air into the soil which is so necessary for nitrification. Before planting the soil must be forked up again and thoroughly pulverised. The "Planet Junior" single cultivator is an excellent tool for this purpose, it will soon repay its value by the saving of labour otherwise necessary for successful cultivation.

Soil.

The soil most suitable for the growing of Citrus trees is one that is deep, rich and mellow with a fine substratum, but of a nature to allow water to percolate easily. Gravel or coarse sand on the surface is all right as long as the sub-soil is good. Suitably good soils should always be chosen it fruit of a good quality and big crops are to be expected. Low-lying ill-drained land will not grow trees of the Citrus family.

Transplanting.

Orange trees can easily be transplanted if the following instructions are carefully carried out:—Dig up the young plants, avoiding as much as possible doing any damage to the roots, any damaged roots must be trimmed by a clean cut before planting. Do not let the roots be exposed to the sun or wind, and do not let them dry. This precaution is most important otherwise a large number of plants will be lost. The plants must be planted at the depth they were in the nursery, in a hole large enough to receive the roots without cramping them. The earth must be pressed firmly all round, and some water added to settle the soil. The planting had better be done during the

rainy weather. It is advisable to cover up the plants for some time; this is easily done with baskets made from the half of a green coconut leaf, the basket being placed over three stakes driven in round the young tree. The basket need not come down to the ground. There shoud be a few inches of space between the basket and the ground, to allow the free circulation of air. The covering is necessary at first so as to give the trees a chance to recover and establish themselves in the soil. It also acts as a protection of the stock from the fierce rays of the sun, which is always detrimental to citrus trees. It is advisable to prune back the young trees. It will give the trees a better chance of recovering. In fact, a young tree pruned will recover sooner than one un-pruned. Manure must not be applied too close to the young trees.

DISTANCE APART.

Distance apart mostly depends on the soil in which the trees are to be planted and the kind of trees. Seedlings can be planted 30 feet apart and budded or grafted trees 25 feet apart. Trees planted a good distance apart can always withstand the dry seasons more so than those planted close. It is a mistake to grow other produce in the orange grove, except when the trees are very young. Some vegetables or maize might be grown at this period without doing any material injury. They must not, however, be grown too close to the orange trees.

FERTILISERS.

For supplying what the soil is lacking and what the orange takes out of it, one must be guided by the analysis of both—the soil and the ashes of the fruit. It has been found by analysis that the fruit ash chiefly contains phosphoric acid, lime and potash. By a proper combination of various elements used in fertilisation one can undoubtedly largely govern the quality and flavour of the fruit. Free use of potash thickens and toughens the rind, increasing the value of the fruit for storing and transporting long distances, but this is accomplished at the expense of the sugar in the fruit. To sweeten the fruit use sulphate of ammonia in large quantities and decrease the amount of potash. To obtain fruit with thin rind use nitrogen from inorganic sources in moderate quantities with considerable potash and lime.

Farmyard manure can also be used with excellent results, only it is not possible to regulate it and use it for the special purposes indicated above. But it must not be forgotten that the continued use of artificials alone tends to exhaust the soil, and does not affect any mechanical action in the soil; so that it is always advisable to use both manures at different times.

A very good manure for a fairly strong soil is:—Nitrate of soda, 1½ cwt.; Concentrated superphosphate, 1½ cwt.; and Sulphate of potash, 1 cwt. 4 cwts. would be a heavy dressing; less could be used with good results. Nitrate of soda contains from 15 to 16 per cent. of nitrogen, concentrated superphosphate about 40 to 45 per cent. of phosphoric acid, and sulphate of potash (high grade) contains from 50 to 55 per cent. of pure potash.

PRUNING THE ORANGE.

Once the trees are planted out it is advisable to let everything grow for the first year, as we have already just before planting cut the trees back to enable them to more quickly recover from the shock they received in having their roots cut, etc. In the second year take off the bottom shoots as high up as from 12 to 15 inches from the ground, and the third year form your tree by starting the crown about 24 inches from the ground. This is very important, for as a rule we have in Ceylon trees starting their crowns 5 to 6 feet or more from the ground, and in course of time balloons will be required to pick the fruit from such trees! Never allow your trees to go up like coconut palms, start them low, and make them spread out, don't forget that we have allowed 25 feet between the rows. Orange trees planted under other trees will never do much good, they always have a tendency to go up, and they hardly bear any fruit.

If a branch has a tendency to go up cut it back during the rainy weather, always making a clean cut. The best tool for this purpose is the French pruning shears with a spiral spring. They are being sold by the Fort ironmongers at R. 2 each. In cutting a branch always cut it at an angle, holding the branch with your left hand and slightly pressing the branch away from the cut. Cutting the branch at an angle prevents any water settling, and it makes a quick recovery. If the branch is a big one use a saw, and trim the bark round the cut with a sharp knife.

When once we have a well-balanced tree with branches evenly distributed around it, and it has started bearing, it is advisable to clean any rubbish, or small branches in the centre of the tree to enable a free circulation of air. When the tree has attained any size say in its fifth year, any laterals

projecting from the side or top may be cut off so as to keep the tree evenly balanced and fairly compact.

CULTIVATION.

It must be understood that heavy soils require a cultivation different to that applied to light soils, and hillsides have to be treated different to flat land. Good cultivation is the secret of success. What is meant by "intense culture" is very little understood in Ceylon. I shall therefore go into the subject. Cultivation means the admission of air into the soil so necessary for the development and working of the bacteria in it. This bacteria changes the insoluble plant food in the soil into soluble food. This is to say, it converts the nitrogenous compounds in the soil into ammonia. This is the first process which takes place in the soil in the case of all natural nitrogenous manures, and is caused entirely by the bacteria. This process is called "nitrification," and the bacteria which are instrumental in bringing about this state of things are called "nitrifying bacteria." These bacteria must have air and warmth, and the better these conditions are the quicker the ammonia will be formed. The second process is brought about by the air which changes ammonia into nitric acid. The nitric acid then combines with an alkaline base, such as potash, soda or lime and forms nitrates. It is in this form as nitrates and in no other, that they can be dissolved by the soil moisture and absorbed by the trees. It is therefore obvious that this all-important nitrification requires the presence of free oxygen (air), warmth and moisture, and the only possible mode of supplying this is by liberal and thorough cultivation.

There is another possible change which might take place in uncultivated soils and is harmful. It has been stated that, ordinarily, the bacteria which causes nitrification require air. There are, however, bacteria which can cause organic matter to ferment in the absence of free oxygen. Oxygen is necessary for fermentation, and in the absence of free oxygen these bacteria obtain their supply by breaking up any nitrates that may be present, using the oxygen of the nitrate and allowing the nitrogen of the nitrate to escape as a gas. These bacteria are therefore very injurious to the productiveness of soils, since they destroy the valuable nitrates and allow the nitrogen to escape. Their effect is directly opposite to nitrification, and hence it is called denitrification. So it is again obvious that

CULTIVATION IS VERY NECESSARY

to admit free oxygen into the soil to bring the valuable plant food into a form that will make it readily available. Cultivation is also necessary to prevent the denitrificating bacteria from obtaining the oxygen from the nitrates and letting loose the valuable nitrogen into the air. It is also necessary for retaining the moisture that is in the soil. Water is evaporated into the air by means of fine hair-like tubes formed in the soil and known as "capillary tubes." These tubes are absolutely necessary for bringing up moisture from the subsoils, but if not checked, the moisture will be lost, The only way to check this loss is by cultivation. The frequent breaking up of these tubes means the minimising of evaporation. Moisture in the soil is necessary for two purposes. Available plant food can only be taken up by the roots when it is dissolved in the soil moisture, and nitrification cannot take place without moisture, so that insoluble plant food cannot be made soluble without moisture, and without cultivation moisture is not considered in the soil.

Again, uncultivated, hard, compressed land does not allow the rain to soak into it, but the water, running over the surface of the land, carries the vegetable matter, fine particles of soil, the fertility brought to the surface by the capillary action of the soil, the fertilising elements brought down to the soil by the rainfall, and the best of the manures and fertilisers that may be applied to the soil into water courses, never to return. Each washing of the surface makes the soil more compact, thus adding to the surface flow of the water and to the poorer conditions for promoting the vigorous growth of plant and tree. The injurious effect of such conditions can be plainly seen in many places, the trees being sickly, and bearing small crops when they ought to be vigorous, under favourable conditions and in season bear abundance of fruit.

THE REMEDY FOR UNFAVOURABLE CONDITIONS

of soil and waste of fertility is the thorough cultivation of the soil, and subsoil and under drainage. On clay lands having a retentive subsoil, cultivation is the first step to be taken in providing the right condition for successful tree growing. If the subsoil is so hard and tenacious as to be what is known as a "hard pan" so much the more does it need to be cultivated to a depth sufficient to allow the roots of the trees to penetrate for food and

moisture. It is for this purpose that I recommend that the soil should be trenched, or subsoiled, to a depth of eighteen inches before planting. The removal of the excess water through the soil and subsoil to the under drains opens millions of little waterways which the roots of the trees may penetrate for food and moisture. By the removal of the water which fills the spaces in the soil, the air, so necessary in the preparation of plant-food, as pointed out, enters the soil to do its work. The rainfall enters the well-drained soil at the points where it falls, carrying the fertility washed out of the air and that which has been brought to the surface by the capillary action of the soil and subsoil and the best of manures and fertilisers which have been applied down into the soil where they may be utilised as food to the growing tree. The film of moisture covering the particles of soil is sufficient for plant growth and has an upward capillary flow carrying soluble plant food to the tiny rootlets as it moves towards the surface. When the rainfall comes there is a downward flow of water performing a like mission. In a well cultivated soil we have free access of water, heat and air so necessary to plant growth; while all applied fertility in the way of manures and fertilisers is made available. Cultivation also prevents the growth of grass and weeds which invariably robs the soil.

The Best Methods of Cultivation.

The best method of cultivation is to turn up the soil during the rainy season once a year, and to keep the soil well stirred to a depth of five or six inches during the rest of the year. The roots of the trees should be encouraged to go lower than the five or six inches of cultivation, as it must be distinctly understood that the roots of the Citrus family must not be damaged in any way. Training the roots to keep down is very simple if the trees are planted in deeply trenched or subsoiled land as has been recommended, and if cultivation in the form of ploughing and subsequent stirring up of the soil is carried on year in and year out. If this is thoroughly and systematically done it will be found that the roots will prefer the congenial well-drained, moist soil below, which supplies it with abundant assimilable plant-food, rather than the dry surface soil. Also trees having a foothold in sufficient underdrained soil are not likely to be injured by severe droughts or long continued rainfall.

Ploughs and Cultivators.

Where possible a suitable plough should be used for turning up the soil once a year, and it is pleasing to note that ploughs of a reasonable type have at last been introduced into Ceylon, thanks to Messrs. Walker, Sons & Co. It is important to remember that different soils and conditions require different types of plough, so that one must not condemn a plough he has procured because it does not suit his conditions. I remember the case of a splendidly constructed Ransomes, Sims and Jeffries double furrow plough which was found useless in turning up lands of modern cultivation in Australia, while no doubt it would have done excellent work on an English farm which had been subjected to centuries of cultivation. The plough, although entirely built of the best steel and iron got bent beyond working order, the cause being that it was far too light in construction for the heavy, newly-tilled soils of Australia. There are many points to be considered in buying a plough—the nature of the soil, the depth to which one intends to plough, the draught power available, etc., etc. It is best for the novice to get the best advice procurable before he buys his plough. It must also be remembered that the best plough and the best draught power will not do the best ploughing if handled by an incompetent ploughman. Everything depends on the man behind the plough. Ploughing looks simple enough to the onlooker, and many have argued with me that there is nothing in it, and that it is very simple. Let anybody who holds such an opinion try ploughing for an hour or so he will find that the harmless looking implement can become an instrument of torture, and play many pranks with him. It takes months and years for a man to learn to plough, so that if a person wishes to turn up his soil, cutting every inch of it to an even depth, he must train the most intelligent men he has and make them stay with him by paying them better wages as ploughmen. He will find that he will not be a loser by it as he will undoubtedly get better yields from his land than from badly ploughed land. Of course these remarks do not apply only to orange cultivation but to all cultivation.

After the plough has done its work, preferably twice—that is to say, ploughed and cross-ploughed—and the rainy season is over, then should be introduced the "Planet Junior Cultivator," or any other implement of the same stamp. These machines can now be procured from Messrs. Walker, Sons & Co., and Brown & Co. This implement is for the purpose of breaking up the surface

capillary tubes and minimising evaporation, thoroughly mixing and distributing any manure and fertilisers that may have been applied, and also for bringing the soil into a thoroughly mechanical state. It will also keep down all weeds if the "duck feet" attachments are put on. This machine has only to be worked for a short time to be fully appreciated. It is cheap and light of draught, and a pair of ordinary bulls could work it easily. It is not meant for turning up unploughed soil, but once the land has been ploughed or turned up, this "multum-in-parvo" will keep the orangery thoroughly cultivated to any depth necessary, and also keep down the weeds at very little cost. I am not theorising in these matters but speak from personal experience. I grew oranges and other fruit trees on

AN ORCHARD OF 20 ACRES IN AUSTRALIA

where the average rainfall was 14 inches, and we had to entirely depend on irrigation, the water being pumped from the river Murray at an enormous cost. Some idea of the cost can be gauged when it is known that it cost £10,000 for firewood alone for one year to irrigate the 25,000 acres of irrigable land on the river, each land holder having to pay £1 per acre for water per year. Owing to the great cost, and the water having to be distributed over this vast area, each land holder only got his supply at stated periods, amounting to about three irrigations a year. This limited supply of water we found sufficient, because we carried out the form of intense culture. The whole of the Summer cultivation was done by myself, by means of a single light draught horse, and one single horse "Planet Junior Cultivator." The place was kept in a thorough state of cultivation and without a single weed. I imported one of these implements into Ceylon about eight years ago for the special purpose of working a citrus grove that I planted on an estate I was supervising, and I found that an ordinary pair of cart bulls could work it easily, and it did excellent work. After every shower of rain during the dry months, when the land is dry enough for cultivation, that is to say, not sticky and will not form lumps, but break up fine, it should be cultivated, as the rain has undone what the cultivator has been doing all the time, that is of breaking up the surface capillary tubes and keeping them broken. The rain has made the loose soil compact again, and so reformed the capillary tubes which must be broken up again and kept broken. It is not only after rain that the cultivator must be put on, but whenever the soil gets compact. Even during the long dry months it will be noticed that the soil forms a sort of surface crust. It means that you are losing a valuable lot of soil moisture just at the time your trees require it most. Some might say that all this reads very fine on paper—that it is a lot of scientific theory, and what might have answered in Australia will not answer here, and so on. But I would ask the most sceptical to try a small experiment for himself in his flower or vegetable garden. Let him, if he is planting out, trench his soil to a depth of 18 inches beforehand and mix up the usual quantity of manure with the soil. When the plants have gone beyond the nursery stage let him water the plants once in four or five days, giving the soil a good drenching, and when the soil is dry enough for cultivation let him use a pronged hoe, or even a mamotie, and cultivate the soil to a depth that would not injure the roots, finishing off with a garden rake. If he does this in an unprejudiced and thorough manner, he will find that he will have better flowers, or better and more vegetables from his garden, watering lightly—daily does more harm than good. Cultivation increases the yield.

VARIETIES.

The procuring of the best varieties is absolutely important as they always command the best price. Producing and cultivating a seedling orange tree is like drawing from a lucky bag, as you never know what you will get until you have got it. You never know, by planting orange seeds, what you have, as the plants may turn out oranges, or limes or any other member of the citrus family. Even if you have an orange tree you never know whether the fruit will turn out good, bad or indifferent. So, it is obvious that it is more than advisable to plant wisked trees; budding them yourself, or procuring them from a reliable source. I planted Australian budded Orange and Lemon trees in this district with every success.

The best imported variety is the Washington Navel which is practically seedless, and the trees have hardly any thorns. They do not grow up to any great size, but growth is rapid and they bear in quick time; producing one of the finest, if not the finest, oranges in the world. The fruit is large, solid and heavy; skin, smooth and of fine texture, very juicy and highly flavoured, and has at the end a navel-like scar where the flower had been,

The Maltese Blood is another choice variety which derives its name from the dark colour of the fruit which is streaked and mottled with red. The fruit is of medium-size, oval, juicy, fine flavoured, thin skin, and fairly smooth, and has but few seeds. The tree is thornless and of dwarf habits, and can consequently be planted closer together; it is a prolific bearer.

The Mediterranean Sweet is a thornless tree of dwarf habits and a prolific bearer, inclined to bear too heavily. Fruit, medium to large, very solid, and with few seeds; pulp and skin of fine texture. This is an excellent carrying orange.

The Joppa is another fine orange. It came originally from Joppa in Jerusalem. The fruit is large, roundish-oval, firm, of deep orange red colour, nearly seedless, thin skinned, sweet and juicy, ripens early, and hangs well. Tree thornless, upright and vigorous; good bearer.

The Jappa is an excellent variety, largely grown in Turkey and Egypt. Fruit large, oval and somewhat narrowed at the base, very sweet and juicy. Skin smooth and highly coloured. Trees of only medium growth and heavy cropper.

Marketing.

In picking oranges, care must be taken not to injure them, as bruising, however slightly, will cause early decay. The fruit, for either keeping or for the market, should always be clipped with a pair of clippers leaving a little of the stem, it must not be pulled off the tree as is the usual practise in Ceylon. The fruit should always be allowed to get fully ripe. If for keeping for any length of time or for export they should be picked in this stage, but never before, as an orange picked while yet green never makes a good sweet fruit, but for quick sales they can be allowed to hang on the tree after ripening. Oranges for storing should never be picked in damp weather. If there has been two or three days' rain the oranges should not be picked for a week afterwards, as the rain tends to soften and swell the rind, and in consequence the fruit does not keep well.

Storing Oranges.

I have kept oranges in Australia for six months in slightly damp sand free from vegetable matter, treating them thus. After they were carefully picked with a little of the stem attached to them, and at a proper degree of ripeness, they were allowed to stand in large boxes of little depth, in a cool airy room for three to four days to "sweet," that is to get rid of some of the moisture in the rind. They were then packed in sand very slightly damp in large boxes, ordinary large packing cases being used, taking care that the oranges did not touch each other. After six months they were found to be in excellent condition and sold at best prices in the Melbourne market. I have known oranges to keep a year by this simple process. A friend of mine preparing to pack his crop of oranges, in emptying the sand from the boxes he had previously used, came across two or three oranges that had been accidentally left when the last crop of oranges were sent to market. They were then one year in the boxes and in perfect condition.

It must be remembered that bruised oranges, and those not of a proper degree ot ripeness, or those pulled from off the tree, will not keep.

—*Ceylon Independent.*

HORTICULTURAL COURSE.

(*University of London, S. E. Agricultural College, Wye, Kent.*)

The course of instruction in Practical and Theoretical Horticulture extends over two years (six College terms), but students attending this course are strongly advised to spend at least three of the vacations in the orchards of the College or of an up-to-date grower, so that they may be familiar with the operations of a complete year. The course of instruction is under the direction of a successful commercial fruit-grower, who gives the practical instruction in the orchards and by means of lectures.

At the end of the course, in July, an examination is held and certificates awarded to those students who satisfy the examiners in the different subjects of the course, and who have regularly attended the lectures and practical classes.

Students in the Horticultural course can obtain instruction in Poultry and Bee-keeping, and have access to all the College equipment—library, reading-room, museum, etc. They are under the same rules and regulations with regard to fees, residence, etc., as other students attending the College, details of which will be found in the College prospectus.

The following is an out-line of the work to be completed in the two years course:—

COMMERCIAL FRUIT GROWING COURSE. (C. S. SMITH.)

First Year.—Preparation of and setting out ground for planting. Best time of year to plant. Method of planting. Proportion of acreage according to capital and labour obtainable. Selection of suitable varieties for different soils and situations. Proportion of varieties in order to obtain a continual supply of produce. Care of plantations. Wireing to prevent damage by rabbits, hares, etc. Staking and trying. Winter pruning of apples, pears, plums, currants, gooseberries, etc. Summer pruning. Selection of stocks. Grafting and budding. Cultivation and manuring. Gathering, grading, and packing.

Practical Work.—Planting, pruning, grafting, budding and staking trees. Gathering, grading and packing fruit. Washing trees and bushes for insect and fungoid pests.

Second Year.—Selection of a farm. Suitable localities for fruit growing. Situations—desirable and otherwise. Capital required. Agreements, rent, etc. Remodelling old plantations. Management of orchards. Utilization of wall space. Recognition of varieties. Packing and marketing. Piece-work and management of men. Cost of planting. Cost of upkeep. Returns.

Facilities are obtained to enable students to visit other fruit farms where fruit-growing operations on practical commercial lines may be seen in progress.

Practical Work.—Planting, pruning, grafting, budding, etc. Selection and valuation of trees for planting. Naming varieties. Gathering, grading and packing fruit.

VEGETABLE CULTURE.

General principles underlying the growing, storing, and marketing of vegetables. Special requirements, cultivation, manuring, and general management of different vegetable crops. Forcing—vegetables under glass—French systems. Market houses: their construction and management. Propagation by seeds, cuttings, layers, etc. Special crops: watercress, mushrooms, mint, lavender. Disposal and sale of vegetables; systems of marketing.

Practical Work.—Students will take part in the cultivation of the market garden and vegetable grounds and in the work of the glasshouses, &c.

CHEMISTRY.

First Year.—Chemistry of the commoner elements and their chief compounds. Elementary physical chemistry. A limited number of types of organic compounds.

The Plant.—Constituents of plants and their distribution. The relation of the plant to air, water, light, food material in the soil. Chemical changes during germination, growth and maturation. Effects of soil, season and manuring.

Second Year.—The Soil. Origin, composition, chemical and physical properties of soils. Relation of soil to temperature and water. Effect of tillage. Improvement of soils.

Manures.—Composition of dung, changes which it undergoes in the heap and in the soil. Green manuring. Origin, composition and properties of the chief artificial manures, their action and value under different conditions of climate and soil. Chemistry of sprays and washes.

Practical work in the laboratory is concurrent with the lectures, and special attention is paid to experiments illustrating the chemical changes which take place during germination and growth of plants, and to the chemical and physical properties of soils and manures. Analysis of soils and manures is also included in the course.

HORTICULTURAL BOTANY.

The Structure and Functions of a Flowering Plant. The flower—seed—seed testing—seedlings and germination—root—stem—leaf.

The Plant in relation to Soil and Food. Chemical composition—the soil—the food of plants—artificial cultures—manures.

Methods of reproduction. Vegetative propagation—cuttings, layering, etc. Pollination—fertilisation—hybridisation. Improvements of plants by selection and cross fertilisation. Mendel's Law and its application.

Power of Recovery from Injuries. The effect on the plant of bruising, cutting, pruning, grafting, etc.

The Plant in relation to its Surroundings. Damage caused by extremes of temperature and moisture. Methods tried for protecting fruit trees against late spring frosts.

Injury caused by Fungus Pests and Lichens. Character of a fungus—different types of fungi.

Classification of plants. Characters of the principal natural orders to which fruit trees and vegetables belong. Recognition of plants by vegetative characters.

Habits of Growth of different types of Weeds. Methods of extermination.

Practical Work.—Each lecture will be followed by practical work in the laboratory or out of doors.

Economic Mycology.

First Year.—The life-history of the chief fungus pests of cultivated fruit and vegetables. The use of preventive measures, and the preparation and application of fungicides. Spraying machinery; hand and power pumps.

Second Year.—General classification of parasitic fungi. Detection of fungus pests in the field, and their determination in the laboratory. The conditions inducing predisposition of cultivated plants to disease. Indirect methods of control of plant diseases (treatment of seed or stock, special manuring and cultivation). Plant-breeding in relation to resistance to disease. The control of fungus diseases by legislation. "The Destructive Insects and Pests Act, 1907."

For Honours.—Original investigation of problems in plant pathology will be required of each student during a third year's course.

Economic Entomology.

Insect pests of apple, currant, cherry, damson, gooseberry, loganberry, peach, plum, raspberry, strawberry, vine. Fumigation, sprays and spraying. Insect pests of onion, carrot, beet, turnips, celery, cabbage—wireworm, leather jackets, surface larvæ, centipedes and millipedes, rose pests, carnation and other fly maggots, hothouse scale insects. Practical work of observing insect pests and their damage, and of applying preventive and remedial measures in the orchards.

For Honours.—Original investigation of problems connected with insects attacking fruit and vegetable crops will be required of each student during a third year's course,

Book-Keeping.

Principles and methods of keeping accounts by single and double entry. A simple and concise method of keeping fruit-growers' and market gardeners' accounts. Use of cash book; ledger, sales book and wages book. Preparation of profit and loss accounts. Balance sheet and capital account.

Economics of Production.

The elements of political economy—land, labour, capital, rates and taxes, free trade, protection, money, the relation of the State to the producer. Legislation affecting fruit-growers.

Woodwork.

Instruction will be given in the shops in practical carpentry, making frames, lights, etc.

LIVE STOCK.

ANTI-RINDERPEST SERUM, ITS PRODUCTION AND USE.

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Rinderpest has probably caused greater losses to owners of cattle than any other one disease. It has existed for centuries in Asia, was introduced into Europe about two hundred years ago and later into Africa. Millions of animals have succumbed to its ravages in different countries during the past two or three centuries. It may be readily understood why individuals and governments have made every effort in their search for some instrument to use in the suppression of so appalling a scourge. It was rinderpest that first called forth government aid in the support of veterinary colleges and the institution of veterinary police regulations. In the early ages, all of the crude drugs and treatments were applied to the disease, and with the advance of the medical sciences more progressive methods were made available. But no success was attained until after the discovery of the bacterial origin of disease, with the subsequent development of serum therapy and its application to rinderpest. Science experimented with all of the thousands of drugs and compounds of the pharmacist, but ultimately ascertained that the preventative for rinderpest could be obtained from but one source, *the body of the susceptible animal, in the form of blood-serum.*

Anti-rinderpest serum is the fluid portion of the blood of cattle which have been immunized against rinderpest and subsequently manipulated to a state of high resistance to the disease. It is administered by subcutaneous inocu-

lation into cattle and carabaos, conferring upon them a period of immunity that may endure from one to four or five months, during which time they will not contract rinderpest even if exposed. It is merely protective, not curative in action, is of no value in any disease but rinderpest, and is harmless to any animal.

The method by which animals prepare substances which are active against disease is a very interesting study, not yet fully solved, and too complex a problem for more than superficial discussion here. A brief mention of the general theory will suffice. It is generally known that following an attack and recovery from an infectious disease, there ensues a period during which the animal is not susceptible to another attack of the same disease. The duration of this immunity varies in the different diseases. Following foot-and-mouth disease the immunity is for but a few months at best, while in rinderpest it is permanent. This immunity is due to the presence in the blood of certain substances called "anti-toxins," substances which have been prepared by the body forces by reason of the stimulation afforded by the presence of the disease germs. These anti-toxins destroy any similar germs that may subsequently enter the body.

The harmful action of various disease germs is exerted through poisons which they prepare and set free in the body. That is, bacteria, gaining entrance into an animal, do not create disease or cause death mechanically, by reason of their mere physical presence, but by means of poisons, toxins, which they produce. This is true particularly of the more severe diseases of animals and men, such as rinderpest, diphtheria, and tetanus. Similarly, the body in its effort to overcome and eliminate the disease prepares its substances, anti-poisons or anti-toxins, which are poisonous to the bacteria. The blood-serum and certain forms of cells are credited with the production of these anti-toxins. They are carried in solution in the blood, and circulate into all portions of the body, to encounter and neutralize the toxins, and inhibit the multiplication of the germs. Thus the entrance of disease germs into the body is followed by a struggle between the toxins of the germs and the anti-toxins prepared by the body. As in any battle, the issue depends upon the strength and numbers of the combatants. If the bacteria win, the animal dies; if the body wins, it is because it has prepared sufficiently powerful and numerous anti-toxins, set them free in the blood, and thus neutralized the toxins and destroyed the germs.

In rinderpest, the anti-toxins are retained indefinitely, circulate in the body fluid and perpetually guard against another infection by rinderpest germs. Not only will these anti-toxins protect the immune animal from the disease, but if his blood be drawn and the serum inoculated into a susceptible animal, it will also serve for the latter's protection. In other words, the anti-toxin is active when withdrawn from recovered animals and injected into others. It is this fact that permits of serum treatment.

An animal that has just recovered from rinderpest and is therefore immune, is not ready for serum production, as its blood does not contain the requisite number and strength of anti-toxin to protect an animal which is inoculated with a small dose of serum. It is true that if a large amount of blood were drawn, the serum separated and inoculated into another animal, the protection afforded would be ample, but this course is not practicable. For economy and convenience it is necessary to produce a powerful serum, so that a small inoculation will furnish the desired degree of protection. In order to accomplish this strengthening of the serum, it is necessary to administer gradually increasing doses of the germs of rinderpest, which, while harmless to the now immune animal, cause him to produce more powerful anti-toxins to neutralize the injected virus. These injections are given in a regular series, a regular dose being given each time, until a stage is reached when the animal is considered as fit for serum production and is bled.

In the preparation of anti-rinderpest serum, practical application is made of this theory. But few animals are immune to rinderpest when admitted into the serum head, so the first step necessary is to pass them through the disease. A mild form of rinderpest is induced by the inoculation of a small amount of virulent blood and a large dose of serum. The serum is given to inhibit the action of the disease, so that the animal will recover after enduring a light attack of rinderpest. The more violent symptoms seldom develop in animals so treated. If the serum were not given, a mortality of about 90 per cent. might be expected, but with its use the percentage is reversed. Usually the disease is in evidence within a week after the injection of virulent blood, and subsides after another ten days. The animal has now experiendce

rinderpest and is immune for all time. The blood serum contains the normal anti-toxins of immune animals, which must now be stimulated to much greater activity.

The immune animal is maintained under good care and careful feeding until normal tone and good flesh is recovered, and then injected with a larger dose of virus, 10 cubic centimeters being given at this time. Neither this nor any of the succeeding injections is followed by any visible reaction. About ten days later, 100 cubic centimeters is injected, and ten days later this is followed by 600 cubic centimeters. A week later, the animal is bled the first time. Subsequently, at certain intervals between bleedings, injections of 1,000, 1,500, 2,000, 5,000, and 3,000 cubic centimeters are given. Three bleedings are made in as many weeks between each of the series of injection of virus. Following the last bleeding after the injection of 3,000 cubic centimeters of virus, the work of immunizing the animal is completed and it is sold at public auction. The process of hyperimmunization could be carried a few steps further, but it is abandoned at this stage, the cost of the virus being out of proportion to the advantage of maintaining the same animal in the herd.

In the production of any serum it is necessary to use large amounts of the virus of the disease against which the serum is to operate. In some cases the germ may be isolated and grown artificially, but this is not true of rinderpest. The only known method of obtaining rinderpest virus is from the bodies of sick animals. A quantity of virulent blood must be available about twice a week. For this purpose small male cattle are infected with rinderpest and bled to death at the stage when the temperature is at maximum height, when the blood contains the most powerful toxins, and more blood may be obtained than at a later period when the animals are emaciated by the assault of the disease. Two hours before death, 10 to 15 liters of weak saline solution is introduced into the abdominal cavity at body temperature, and is secured after death. It is used for injection in the same manner as the blood, being of nearly equal virulence, and producing similar reaction. By the use of this abdominal fluid we double the quantity of virus obtainable from each animal, reducing by one-half the expenditure for animals for virus. This class of animal is bled to death from the carotid artery.

In bleeding for serum the animals are confined on an operating table and the blood withdrawn from the jugular vein by means of hollow needles connected by rubber tubes to special serum flasks, from which the air has been exhausted to facilitate the passage of blood. Three liters is usually taken from each animal at one bleeding. No ill-effects attend the operation, unless a slight dizziness, that is occasionally observed, is worthy of mention. The blood is received into tall cylindrical flasks, kept at room temperature for six hours and then placed in cold storage for the balance of twenty-four hours. During this time the blood coagulates, a firm clot drawn by means of side tubes with which the flasks are provided, and is ready for use after being passed through porous filters for sterilization. For shipment into the provinces the serum is put up in bottles of 300 cubic centimeters, enough for the inoculation of six animals. Every flask, bottle, tube, and instrument used in connection with the production of serum is subjected to sterilization by steam heat, and every possible precaution taken to prevent contamination.

The important essentials for satisfactory serum animals are size, youth, docility, general soundness, and susceptibility to rinderpest. Chinese steers are in many ways the best animals in the East for serum purposes, but very few of this type have been available during the past year because of the prevalence of infectious diseases at the sources of supply. The serum herd is at present made up largely of Indo-Chinese animals, which are larger but more difficult to handle and maintain in good condition. The cattle are highly fed, as otherwise the continual bleeding would result in emaciation. They are stalled in large open sheds, being allowed several hours' exercise in the pastures each day, excepting one day immediately preceding and one day following bleeding or inoculation. It might be said that they enjoy their existence at the laboratory, as it is certainly an easy one. Each animal is retained for about a year and then sold, bringing considerably more than its purchase price, the added value lying in its immunity to rinderpest and good condition upon discharge from the herd.

At present the serum herd is composed of about three hundred head, all of which are in actual use for serum production. With this large herd the weekly production has averaged 180 liters, or sufficient to inoculate over 3,000 cattle or carabaos with the usual dose of 50 cubic centimeters.

In the field work against rinderpest, the serum is injected subcutaneously by means of hypodermic syringes, each animal treated being given a dose of 50 cubic centimeters. There is but slight pain attendant upon the injection, as it is performed with small needles that are merely thrust through a loose fold of the skin. Excepting with very nervous animals, it is unnecessary to confine the cattle during the operation otherwise than in rough stocks. The antitoxin is active almost immediately after the injection, as the serum is rapidly absorbed into the blood. The serum is perfectly harmless, the inoculation being followed by neither a local nor a systematic reaction. There is no reason why a moment's time should be lost from work, excepting the time necessary to bring the animal to the place appointed for the inoculations, the one or two minutes necessary for the injection, and its return to the field.

The degree of protection afforded animals by the inoculation of 50 cubic centimeters of serum varies considerably, because of differences in their natural susceptibility, in the virulence of each outbreak, in the strength of the serum, and other remote causes. The usual result is an immunity extending over a period of from one to four or five months. During this time the inoculated animals are as a rule immune to infection despite possible exposure. A small percentage of treated animals are infected in spite of the inoculation, but in these the disease is usually in light form and a majority recover. These light attacks and recoveries are highly desirable from the owners' viewpoint, as they result in permanent immunity of the affected animals. They interfere with the work of the Bureau, however, as an animal suffering from a mild form of disease may spread the contagion as rapidly and widely as one which experiences an acute form and eventually dies.

The Bureau of Agriculture has been preparing and using anti-rinderpest serum for about three years, during which time almost uniformly good results have been obtained in handling rinderpest by the serum method. For a long time there was a disinclination among owners to assemble their animals for inoculation, but more recently little difficulty has been experienced in effecting the necessary treatments.

A few complaints have been registered against the serum, as inoculations fail at times to produce the desired immunity. It must be borne in mind that there is no serum or treatment for any disease that will be efficient for every individual. Even with the most powerful serum it cannot be hoped that every treated animal will escape infection. Anti-rinderpest serum, properly prepared and kept, will protect over 90 per cent. of treated animals, as shown by the results obtained during the past two years. In the fiscal year of 1907, a total of 16,495 animals were inoculated, with 269 reported deaths, a mortality of 1·6 per cent. In 1908 a total of 21,005 were treated, with a mortality of 621, or 2·95 per cent. It is impossible that all deaths following inoculation were reported.

A majority of justified complaints are attributable to the serum being aged when used. It is of delicate organization, deteriorating rapidly unless kept cool, and is particularly susceptible to the action of the sun. As cool storage is seldom available in passage of freight, serum may be considered as losing in efficiency with each day following shipment from Manila.

There is prevalent in some quarters a mistaken impression that the serum is a curative agent. As has been often pointed out, its action is almost wholly preventative, but slight benefit being derived from inoculation of sick animals. The serum, injected before disease has fastened upon an animal, may combat entering germs and prevent their provoking the anatomical changes characteristic of rinderpest, but after these changes have occurred the serum is practically worthless.

In the suppression of any infectious disease, the object in view is the destruction of the germs of the disease. In Europe and America, where funds are available for the purpose, this is accomplished by the slaughtering of all animals that are sick or exposed, and the disinfection of all infected premises. Indemnity is paid for all animals destroyed, and the carcases are either burned, disinfected chemically, or buried at a depth that precludes the possibility of infection rising from that source. This is of course the best method of handling infectious diseases, but is not possible here at present because of the lack of funds to indemnify owners of destroyed animals. In the absence of means to handle rinderpest in this way, the method now in practice is the best that can be pursued.

The theory involved in the serum method is the rendering immune of all susceptible animals in infected districts, the confining of the sick in corrals, the limitation of the movement of susceptible animals so far as possible, and the

disinfection of infected premises. As in the other method, the effort is toward the destruction of the virus, but less directly, the idea being that all animals having been rendered immune for the time being by serum inoculation, the disease will be checked automatically because of the want of susceptible animals in which to propagate. Further spread of the infection is controlled by the isolation of the sick, that they may not come in contact with the healthy animals. The object in establishing quarantine lines to control the exit of carabaos and cattle is to prevent the carrying of the contagion by animals which are in the initial stages of the disease and therefore not readily recognised as having it.

It is unnecessary to add that it has never been possible to accomplish perfectly the four essential principles, viz., (1) inoculation of all susceptible animals, (2) isolation of the sick, (3) quarantine, and (4) disinfection of infected areas. It is difficult to gather every animal for inoculation, even if the supply of serum is ample, which has seldom been the case. Owners of sick animals often conceal them to prevent their isolation. Lawless individuals too often evade the quarantine lines, escaping with their animals into clean districts and spreading the diseases as they go. The infected areas are often so large that complete disinfection is impracticable.

To a great extent the chief factors that have interfered in the work have been attended with the public's lack of knowledge of the general conditions tending toward the spread of the disease. This is of much less significance now, as stock owners are taking a keener interest in the problem, and expressing this interest by more satisfactory co-operation.

Rinderpest, because of its short period of incubation, ready identification, limitation to ruminants, short life of the virus in the sun, and availability of serum therapy, is more readily suppressed than some of the other infectious diseases, providing it is possible to institute ideal conditions in the work. Failing in any of those conditions, it is one of the most difficult to handle, because of the extreme rapidity with which the contagion of rinderpest is disseminated.

The rapid elimination of rinderpest as a grave factor in the economy of the Islands seems assured, now that the entrance of the disease has been impeded by legislation, satisfactory quarantine facilities have been provided for cattle at each port of entry, a large corps of veterinarians have been stationed in the provinces, the serum laboratory has been improved to meet the increased demand for serum, and the public aroused to the necessity of intelligent activity in their own defence.

Diseases which may be mistaken for Rinderpest are :—

I. *Malignant Catarrh of Cattle.*—In many respects this disease resembles Rinderpest, but there is excessive swelling of the eyes, there is no active contagion and the disease does not run through the herd.

II. *Thrush of the Mouth.*—This occurs only in very young stock, fever is absent and abdominal derangement is slight.

III. *Foot-and-Mouth Disease.*—The lesions in the mouth appear more like blisters, and when they break leave a healthy-looking red patch. Fever is slight and diarrhœa is absent. In foot-and-mouth disease the feet are nearly always affected and the disease is seldom fatal.

IV. *Dysentery.*—In this there are no lesions in the mouth, the peculiar Rinderpest odour is absent and it does not spread.

V. *Gastro-Enteritis.*—This disease has recently been brought to notice in British East Africa, and in many cases its resemblance to Rinderpest is remarkable. In some animals which succumb to the disease the lesions are identical with those of Rinderpest. The chief points of difference are (*a*) Full grown animals frequently recover. (*b*) It is the young stock which die, and in these anæmia is nearly always constant, whereas in Rinderpest every mucous surface is in a state of congestion. (*c*) The Rinderpest odour is absent. (*d*) Diarrhœa is not so severe as in Rinderpest, there is not the constant straining with exposure of the rectum. (*e*) The spread of the disease is slower than in Rinderpest.

Mortality.—On the introduction of Rinderpest into a country in which it has not previously existed the mortality reaches 90 to 95 per cent. In countries where Rinderpest is endemic, or at the end of an outbreak which has lasted a considerable time, and when the virus has become attenuated the mortality is not so great, the figures varying from 10 to 50 per cent.

Inoculation for Rinderpest.—In 1897 Koch advocated subcutaneous inoculation of clean animals in the vicinity of a Rinderpest area with bile taken from an animal just dead of Rinderpest, or

slaughtered in a late stage of the disease. The best bile is that obtained from an animal which is killed on the tenth day after artificial infection, or on the fourth or fifth day after visible signs of disease are noticed.

The results of bile inoculation have been very varied. There is no doubt that it saved many thousands of cattle in the outbreak of 1896 in South Africa, but the difficulty is to know the exact properties of the bile employed.

It is probable that the bile of an animal affected with Rinderpest contains the active virus of Rinderpest, and also some immunising substance is formed in this bile. The proportions of the virus and immunising substance vary, so that in one bile the virus may so far predominate as to produce an active immunity or even a fatal attack of Rinderpest when injected into a susceptible animal. In another bile the immunising substance may be in sufficient quantity to render negative the action of the Rinderpest Virus and thus produce merely a passive immunity lasting for a varying and uncertain time. It appears that this virus which exists in Rinderpest bile is modified in biles of animals which have been sick for more than six days by this immunising substance. It is certain that inoculation with fresh Rinderpest bile has produced Rinderpest, but it is generally admitted that if a bile is kept for two or three days it will not cause the disease. Although in the early days of bile inoculation, only biles of a dark green colour with a white froth were used, it has since been found that all clear biles may be used except those which are blood tinged, very thin, light yellow, cloudy or with a putrid smell.

To ensure as far as possible that the bile used for inoculating a herd should have a uniform effect, it is advisable to mix those biles which are all right and to use the mixed bile within 36 hours of being drawn. Should a supply of ice be procurable the bile may be kept for four days. It is not advisable to keep it longer as its immunising powers will deteriorate. Immunity results from the sixth to tenth day, the former being the earliest date at which it appears and the latter the latest. Immunity lasts for periods varying from three weeks to six months.

To inoculate one hundred head of cattle the biles of about seven Rinderpest animals are required.

To extract the Bile.—Lay the animal on its left side. Cut through the skin and flesh behind the last rib, lift up the ribs and the gall bladder is seen.

Utensils required.—A knife or small trocar and canula, wide mouthed stoppered bottles, or ordinary bottles and a funnel. These should be well boiled before using. The hands of the operator should be cleaned and sterilised. The gall-bladder is raised in the left hand of the operator and a sharp stab made into it with the knife or trocar and canula, taking care not to cut one of the small veins on the bladder. An assistant is ready to catch the bile in the funnel and bottle as it flows out of the bladder. The biles should be kept separate for a few hours; those which are alright should then be mixed together, and unless kept on ice, should be used on the second day after being taken. Neither the person who extracts the bile nor any one who has been in contact with the diseased animal should go near the herd to be inoculated until they have thoroughly disinfected clothes, boots, hands, etc.

The best seat for inoculation is behind the elbow or in the dewlap, and care must be taken that the needle does not enter the flesh, it should pass between the skin and the flesh. The dose of bile recommended is 10 c.c. Some of the mixed bile is poured into a clean cup, which, when the bile is not being taken out of it, should be covered with a piece of linen which has been wrung out in a solution of Jeye's fluid or other disinfectant. The needle should be wiped after each inoculation with a rag soaked in Jeye's fluid, as should the seat of inoculation, the operator's hand and syringe.

It is most important to see that everything used is scrupulously clean and disinfected after the inoculation of each individual animal.

Drawbacks to Bile Inoculation.—(*a*) Inoculation with pure bile does not produce immunity for from six to ten days, so that an animal may contract Rinderpest naturally if exposed to infection before that time has elapsed.

(*b*) On account of the impossibility of determining the exact strength of the immunising properties of bile, the result can never be certain.

(*c*) It is necessary to kill seven animals to obtain bile with which to innoculate one hundred head of cattle. (This bile is much better when obtained from an animal at a certain stage of disease, viz., the tenth day after artificial infection, than from an animal which has died of Rinderpest.]

(*d*) The bile cannot be kept more than a few days, and therefore must be obtained on the spot.

Glycerinated Bile.—Koch having shown that Glycerine destroyed the virulence of Rinderpest blood, Edington, in order to minimise the risk of introducing a fresh outbreak of Rinderpest by the inoculation of pure bile, adopted the method of mixing one part of Rinderpest bile with two parts of Glycerine, and leaving it to stand for eight days.

The injection of such a mixture produces a passive immunity which by repeated injections may be maintained until an outbreak has died out.

An active immunity is frequently conferred by the injection of a dose varying from 15 to 35 c.c. (according to the size of the animal) followed ten days later by the injection of 0·1 c.c. of virulent blood. Ten to fourteen days later a second dose of 1 c.c. of virulent blood is injected, and this in some cases produces a strong active immunity.

In practice, however, in many herds thus inoculated, no visible reaction followed the first dose of 0·1 c.c. of virulent blood, while the second dose of 1 c.c. produces fatal attacks of Rinderpest. In other instances even the blood inoculation produced Rinderpest. These results were due to the unknown strength of the immunising properties of the bile.

To produce an active immunity by this method, without great mortality, the injection of a large dose of glycerinated bile, followed by several blood injections beginning with an infinitesimal quantity and gradually increasing the dose is necessary. This is impracticable on a large scale.

Glycerinated bile will keep for a very long time, and its use is advisable to confer a passive immunity on a clean herd exposed to possible infection, until such infection has ceased.

Inoculation by Serum and Defibrinated Blood.—In 1897 it was shown by Koch that 100 c.c. of defibrinated blood, taken from an animal which had recently recovered from Rinderpest, and injected into a susceptible animal, would protect such animal temporarily from infection. This immunity was only passive and of short duration.

In order to produce an active immunity, susceptible animals, after being inoculated with 100 c.c. of salted defibrinated blood, were exposed to natural infection of Rinderpest, by placing them with a Rinderpest herd or smearing their noses with discharges from Rinderpest animals. This in many cases produced a mild attack of the disease with subsequent immunity; but since in some cases the losses in a herd thus treated amounted to 24 per cent., the method was discontinued in favour of the simultaneous method of Turner and Kolle.

Serum and defibrinated blood exert the same influence, but 20 c.c. of the former are equal to 30 c.c. of the latter; and while the blood must be used fresh, serum to which ½ per cent. of carbolic acid has been added will preserve its immunising power for many months.

Drs. Danysz and Bordet recognised the advantage of fortifying the recovered animals which were used for the production of salted blood. They say, "The production of the preventive substances in the blood is the direct result of a reaction of the organism against the disease, hence, the more serious the disease has been, the more the influence exercised on the body of the animal, and, consequently, the protective qualities of its blood will be the stronger. Therefore, in order to obtain a very powerfully active curative blood, the recovered animal received repeated injections of virulent blood in increasing doses. The more injections of virulent blood applied under these conditions, the more active will the blood of the animal become."

The Serum Simultaneous Method of Turner and Kolle.—This method is the inoculating a small dose of virulent blood on one side of the animal at the same time that the dose of serum which has been found to produce the required effect was injected on the other side. By this means it was claimed that 90 per cent. of the animals had a more or less severe attack of the disease with a loss of about 1½ per cent., while those that did not react were still immune for several months.

The serum is prepared by inoculating salted animals with 100 c.c. of virulent blood. This gradually causes a rise of temperature. When this reaction is over the dose is increased to 200, 500, 1,000, 2,000, 3,000, and 4,000, c.c. at one injection, always waiting for the reaction from the last inoculation to subside before administering the succeeding one.

After receiving 1,000 c.c. of virulent blood, the animal is fit to bleed for the production of serum. About 1,500 c.c. of blood from an animal of 300 lbs. weight or 3,000 c.c. from an animal of 600 lbs. weight are taken on three occasions at intervals of about twelve days, and these three bleedings are repeated between each of the succeeding injections of virulent blood.

Before being used on a large scale it is available to test the serum in order

ascertain the exact dose necessary to confer an active immunity when injected simultaneously with virulent blood.

Serum as a Curative Agent.—Serum possesses strong curative properties, but must be employed in a very early stage of the disease—at the first rise of temperature—and in very large doses. Its action is much quicker when injected directly into the Jugular vein.

The inoculation of serum alone has the advantage over the bile inoculation in that it causes immediate full immunity and is a curative agent in the early part of the disease. It can be prepared in any quantity and will keep for many months.

In comparing the merits of the various methods of inoculation, the conditions of the country and of the outbreak must be considered.

In a country such as British East Africa it is certain that natives will not give up seven per cent. of their cattle to provide bile with which to inoculate their herds; in addition to this, bile has other drawbacks which have been mentioned before.

Whether for producing an active or a passive immunity, the serum inoculation stands alone. The objection to producing an active immunity is that one must use virulent blood and thus introduce Rinderpest and possibily other diseases also in a country in which infectious cattle affections are common. In a country in which Rinderpest occurs, and in which there is a probability of its remaining a long time, it is advisable to confer an active immunity. In an isolated outbreak of short duration a passive immunity is sufficient to protect cattle during the short time they will be exposed to contagion.

Rinderpest in British East Africa.—Since the outbreak which caused such mortality in 1892 onwards, no outbreak on a large scale has occurred South or West of the Tana river. In 1907 Rinderpest was brought from Italian Somaliland, crossed the Juba, and came by Afmadu and Biskaya to the mainland opposite Lamu island. This outbreak was undoubtedly due to Somalis trading cattle. In some marvellous manner it did not cross the Tana river, possibly there was no inducement for natives to take cattle over, nor does it appear to have extended very far West.

Knowledge regarding the existence of Rinderpest, or in fact of any cattle epidemic in Italian Somaliland or the Boran country is very vague and depends chiefly on Native rumours or on information given by white traders.

It is possible that in these countries Rinderpest is endemic and smoulders on, carrying off a few cattle each year about which we hear nothing, since it is not until their cattle die in great numbers that natives take any notice. It must not be forgotten, however, that, if by any chance a sick animal were brought into the settled districts, Rinderpest would cause enormous havoc.

It is manifest that to form a serum station, one must first obtain Rinderpest blood or an animal with Rinderpest. Search was made in Tana land in 1908, but no Rinderpest could be found; the formation of the station had therefore to be abandoned.

Regarding the site for such a station, an island off the Coast, whence contagion could not spread to the mainland, would be the most suitable place; but before finally determining the exact spot, it would be advisable to make certain that Tsetse Fly does not exist there. Once this is determined, some salted cattle might be obtained from the mainland near Lamu and kept handy, to be ready for fortification for serum production as soon as Rinderpest blood could be obtained. Should Rinderpest make its appearance from Uganda or Abyssinia unless serum could be obtained from another country, inoculation with bile would have to be carried on, until a serum Station could be started upcountry.

APICULTURE.

UNITING BEES IN THE FALL.

(From *Gleanings in Bee Culture*, Vol. XXXVII., No. 19, October, 1909.)

A correspondent writes: "I have quite a few weak colonies of bees that I wish to unite this fall. How should it be done?"

Select two weak colonies as close together as possible, and bring them, say, two or three feet toward each other every time the bees have days of flight until the hives stand side by side. Then leave them until the bees have done one good flight while the hives are close together, and after this the colonies may be united at any time when the temperature is 55° F., or above. Sort out from the two hives combs containing the most honey, or at least sufficient for winter stores—an amount that should not be less than 25 lbs. Set these combs in the hive the best way to occupy in the winter, alternating combs from each hive so that the bees will not quarrel.

Having these combs of honey in the hive, put the cover on and shake all the bees from the remaining combs, shaking a comb first from one hive then from the other. The work is now done as soon as the bees have run into the hive, and the empty hive with the remaining combs is stored away.

Where there are many weak colonies to unite, or if, as in the case of a queen-breeder, there are from 50 to 500 nuclei to unite, the above plan involves a large amount of work, especially if such weak colonies are scattered some distance apart. Years ago Elisha Gallup told how to make natural swarms artificially by first smoking the bees and then alarming them by rapping on the hive with a stick, thus causing them to fill themselves with honey. After they were filled with honey, the larger part of them were drummed into a box by the means usually pursued in drumming out bees. When a sufficient number were in the box it was carried to the new location and left leaning up against something for a couple of hours. After this the bees could be hived the same as though they were from a natural swarm.

I tried this same plan for uniting, except that I got all of the bees from two hives into the box, and it worked fairly well until I tried uniting queenless bees from nuclei from which I had previously sold the queens. I found that I could not make the queenless bees stay in the box, as the mother-queen is needed to keep them contented. To overcome this difficulty I made a cage from the upper story of a tiered-up-hive, putting wire cloth on the top and bottom, the bottom piece being nailed to a frame that was fastened with hooks to the hive sc that I could remove it when I wished. A hole was bored through one side of the hive, which side now became the top of the cage. The hole was just right to permit the small end of a funnel, such as was used for putting up bees by the pound for shipping over the country on the plan so much in vogue fifteen or twenty years ago. Over the hole was arranged a large flat wooden button which could be turned so as to open or close the opening as desired.

With this cage I proceeded to a queenless nucleus and blew smoke in at the entrance, after which I gave the side of its hive several blows with my foot or fist. Then I went to another hive and did the same thing. After this I returned to the first hive and repeated the performance, and then again on the second hive. By this time the roaring of the bees inside indicated that they were filling with honey—just what I wished them to do. I therefore waited a minute or two for the bees to take all the honey they would, and as soon as they were filled I shook them into the funnel so that they rolled down through it into the cage below. I soon had in the cage all the bees of the nucleus except the few that were in the corners of the hive or those that took wing before they struck the funnel. Then closing the hole with the button I went to the next nucleus, removed the cover, etc., ready for shaking, and set the cage down quickly so as to jar all the bees in it to the bottom. I soon had the bees of that nucleus in the cage also.

If I wished to get the bees from more than two nuclei I prepared three or four in the manner described before I shook any, so that no time would be lost in waiting for the bees to fill with honey. If four nuclei were smoked and rummed, the first one would be filled with honey by the time I got around to it again to commence shaking. I often put as many as six or eight small nuclei together to make one good colony for winter but four is about the maximum number that can be drummed and shaken at one time; for if more are attempted the bees of the last two or three commence to unload their honey before they are shaken.

When I had all that I wished in the cage, the funnel was taken out and the hole closed, and I proceeded to get the queen that I wished to introduce to them. By bumping the cage on the ground I again jarred the bees down to the bottom, and then I immediately opened the funnel-hole and allowed the queen to run in. Then I rolled and tumbled the bees about in the box until all were thoroughly mixed up and demoralized so that all thoughts of fighting or harming the queen had disappeared. After this I put the cage in some darkened room where the temperature was about 60 degrees and left it until near sunset, when I prepared a hive with combs of sealed honey sufficient for winter stores. By this time I brought the box of bees from the cellar, took off the movable wire-cloth side, dumped out the bees, and hived them as I would a natural swarm. If I did not have enough combs of sealed honey for all, I gave empty combs and fed sugar syrup, as I described lately in Gleanings.

A very essential part in the above method of uniting is to have the bees well filled with honey. If I am afraid that a certain lot of bees in a cage are not full of honey I jar them down and put a quarter of a pound of honey or syrup on them, and then by rolling them about each one gets its share until all are full.

SCIENTIFIC AGRICULTURE.

IMPROVEMENT OF CROPS BY SEED SELECTION.

By R. C. Wood,
Deputy Director of Agriculture, Northern Division.

(From the *Madras Agricultural Calendar*, March, 1910.)

Every one who has observed crops growing in the fields, will have noticed that the plants are not all alike. Thus in a field of transplanted paddy, some of the plants will show more side shoots than others, even though all have the same amount of space and water. In a field of gogu, some plants will have entire leaves, while others will have divided leaves. In a field of jonna some plants have close heads, while others have loose heads. These differences are easily seen, and are well known, but they are not considered of importance. But plants vary just as much in the qualities which we cannot see, as in their outward shapes, and in a field of any crop just as in a crowd of men, there are good and bad mixed up together. Now, according to the Telugu proverb which says (vithoo okti vesthe chettoo okati moluchuna) "If you sow one kind of seed, will a plant of a different kind spring up?" it follows that, if we take only seed from the good plants for sowing the crop next year, there will be a great improvement. How may this be effected? Let us take the case of cotton, as that is a crop in which the process has been carried out for some years at the Nandyal Agricultural Station in the Kurnool district.

The local cotton crop as it grows in the fields is generally a mixture of red cotton (yerrapati) and white cotton (tellapatti), The plants which produce these differently coloured cottons are very different in appearance, the yerrapatti being tall and thin, with short branches, while the tellapatti is a bushy plant with long branches. It is a great mistake to allow any mixture of cottons to be grown in this way, because a mixed lint is, for various reasons, very difficult to spin and weave by machinery, so that the cotton dealers will not give such a good price for it, as for a cotton all of one sort. As the yerrapatti is an inferior plant, it must be got rid of at once, and accordingly all the plants of this sort were pulled out of a corner of a field, so that, though the yield was less, the seed cotton (kappas) picked from that corner of the field was free from any admixture, and was kept separate and not ginned until sowing time. From this seed next year was grown a field entirely of tellapatti plants, so that this simple process led at once to a crop of increased value. But upon more careful examination of the crop, it was found that there were differences even in these tellapatti plants. Some plants produced more bolls than others, some plants ripened earlier than others; some plants spread out their lower branches so that they trailed on the ground and the lint got dirtied, while others grew tall and shapely with heavily laden branches and a pyramidal shape; others again became thin and produced long upright stems bearing very few bolls. From this it was clear that further and more careful selection would have to be made. Accordingly as the crop began to ripen, plants were carefully marked in the field of just the sort it was wished to obtain. The plants were big, strong and properly branched, were healthy, showed no aphis or leaf spot, produced plenty of large bolls which opened properly, with white lint inside. To each of these trees a small cloth bag was tied, a number was given, and the lint picked from each tree and that alone was put into each bag. Thus at the end of the season were obtained a number of bags each containing the produce of a single plant. During the hot weather each of these bags was very carefully examined in the following way. First, the kappas from each bag were ginned, and the seed and the lint separately weighed. It was found as a result that in some of the bags, 100 tolas weight of kappas gave 33 tolas weight of lint, while in others only 20 tolas of lint were obtained. Out of about 150 bags the fifty showing the highest weight of lint were kept. The lint of these was then examined for colour, for strength and for evenness of staple. These are the three qualities which are valuable for cotton, which is to be spun by machinery, and, as most of the cotton in this district is bought by mill-owners, it is necessary to grow only the sort which they want, as they will then be prepared to give a better price for it. The twelve that seemed best were finally chosen and were sown next season in single lines, one to each bag, that is, to each of last year's plants. The best plants of these rows were again chosen in the following year, while the seed from the rest of the plants in the twelve rows is used for the

ordinary farm crop. In the third year, the seed collected from the crop grown on the farm will be distributed in the district; the rejected plant of the second year's selection will supply the seed for the farm, and the twelve best plants will again be the mother plants for next year. This process will be carried out every year, and will result in the stock of farm seed being gradually improved. The actual improvement that has resulted is most marked, though the process has been only continued for a few years. Bales of cotton from two varieties of tellapattti were sent to the Mills the year before last, and the report on them stated that the samples were very good with strong staple and spun well. "Both samples are superior to the ordinary cotton we are receiving from our press, owing to their being of one variety of cotton." Last year they said that the lint was a great improvement on the lint from the country cotton and was more valuable than the lint grown in the previous year.

In an exactly similar way the paddy crop can be improved by picking the seed only from the best heads to use for sowing next year. In places so far apart as Tinnevelly, Malabar and Godavari, an improvement has been seen at once, by giving the plants when transplanted in the field more room, so that they can develop their side shoots more freely. By picking every year seed from the plants which have the most side shoots this property is increased, so that the crop may be transplanted singly, that is, one seedling in each hole, with the certainty of a great saving in seed and the probability of a heavier crop.

MISCELLANEOUS.

THE POSITION OF THE VILLAGE FARMER.

By Dr. J. C. Willis.

[*Paper read before the Board of Agriculture on the 6th April, 1910.*]

In this paper I propose especially to preach upon a variation of what I have for many years made my text in dealing with Ceylon agriculture.

The ordinary villager, who after all is the backbone of native agriculture in the country, is in general in debt to the money lender, from whom he borrows at 50 % interest. It therefore follows that if an improvement in agriculture costs money to initiate—and in the vast majority of cases it does—there must be a *guaranteed* profit of over 50% to make it worth while to borrow the money to initiate that improvement.

Now it is rarely that one can guarantee any *large* profit on an improvement in agriculture, and one may pretty safely say that never can one guarantee 50 %. It will therefore not pay to borrow money to try it.

Not only so, but to borrow more money, the man must have more security to deposit, and this is exactly what in the majority of cases he has not got.

Non-thinking people may remark that under these circumstances one should introduce improvements that do not cost anything. It scarcely needs pointing out that such improvements are very rarely found. Take the case of transplanting rice: it looks at first as if it cost nothing, but it does in reality cost a lot in increased labour, and the only way it might be brought in at present, in many cases, would be to reduce the cultivated area, which is not desirable Any improvement that really costs *nothing* would be adopted at once without much serious difficulty, once it was proved to the satisfaction of the villager that it *was* an improvement.

Now it is just at this point that much amateur work for the improvement of agriculture breaks down. Careful and detailed previous experiment is required to make sure that the proposed change *is* an improvement. Then careful comparison must be made at the same time with the old method, to get at an exact and detailed statement of the relative cost of the two methods, and enquiry must be made as to whether the new method will cause any increased liability to disease, or any violent change in long-established custom; and many other things.

Having decided, after such work, that the new method *is* an improvement, one has then the hardest part of the work to follow, to introduce it. This can only be done, so far as the villager is concerned, by actual demonstration on the spot. It is for this reason, among others, that the school gardens have been so successful. To make a success with other improvements, one must demonstrate them on the spot, and here is where village experimental gardens, kept up by local societies, come in.

Not only so, but the man who is in actual charge of such work must himself be a good agriculturist, and must *win the confidence* of those with whom he has to deal. This means among other things that he must be thoroughly well trained at the commencement at an agricultural school. But, in addition, he should go back every now and then to the headquarters where experiments are going on, and work, under direction, at those experiments till he is thoroughly familiar with every detail. The instructor-superintendent of a village garden should not simply read the published accounts of experiments and then try to instruct people in them. He should himself work at them under the officer who is responsible for them.

This question would occupy several papers to work out in detail, and it will suffice for the present if the general principle is made clear. The man must have the *absolute confidence* of the people, or they will simply laugh at him, and to do that he must have the most intimate and familiar knowledge of agricultural matters, and especially of what he is going to demonstrate.

Now, so long as the villager remains in the grasp of the money-lender, improvements must be confined to those that cost nothing, and as we have said, these are very few and far between. And while he thus remains at the lowest possible level, he becomes in reality lower in comparison to others. The capitalist and the more progressive peasant are continually improving, while he remains stationary. This would not matter if he were entirely self-contained, living *only* on his own produce, or that obtained by exchange from the village artificers, but he wants to *buy*, and to buy he must *sell*, and if he remains stationary, the price of his produce will fall as other people improve.

There is no need for the peasant to be so helpless. He must combine in money matters, on the lines we have often indicated, which of course means that he must at the start get help from richer men or from Government. Richer men are not anxious to lend their capital at a low rate of interest; it pays them better to lend to *uncombined* cultivators at high interest than to the *combined* cultivators at low interest. It thus almost inevitably falls to the Government to aid in the first place. But, and this is important—very important—the cultivators must show, in whatever ways they can, *e.g.*, by supporting the voluntary societies now working, that they *desire* such help. There are many richer people in Ceylon, however, *e.g.*, many Europeans, who would probably be willing to aid in the establishment of a proper village society with a decent capital. The local societies hitherto have had to work on 400 or 500 rupees, which is a mere drop in the bucket. Surely this society could raise funds to start a really first-class society, or raise such a society as that in Dumbara to full efficiency, as a test of such work. I repeat, and shall continue to repeat, that till the villager is set on his legs financially, and taught to combine, he must be the prey of the money-lender and the capitalist, and must remain at the foot of the ladder of agricultural progress.*

J. C. W.

LITERATURE OF ECONOMIC BOTANY AND AGRICULTURE.

By Dr. J. C. Willis.

Maize :—

The hand maize sheller. Ind. Agri. Jl., April 1908, p. 125.

Maize cultivation in Burma. Ind. Agric., Oct. 1908, p. 301.

The cultivation and marketing of maize. Bull. Imp. Inst. 6, 1908, p. 261. "T.A." Dec. 1908, p. 550, Mar. 1909, p. 253.

Jerusalem Maize. Queensl. Ag. Journ. Dec. 1908, p. 271.

Composition of Green Maize and of the silage produced therefrom. Ag. Gaz. of N. S. W., Dec. 1908, p. 1011.

An important tropical cereal. "T.A." Dec. 1908, p. 522.

Maize Breeding in the United States. Agri. News, VII, 173, Dec. 1908, p. 394.

Décret fixant la quantité de mais originaire Nouvelles-Hébrides à admentre en franchise en Nouvelle-Calédonie. L'Agric. pratique des pays chauds, Jan. 1909, p. 4.

Essai comparatif de culture de mais à Thank-Ba. Bull. Economique. Jan.-Feb. 1909, p. 55.

Cultures comparatives de mais à Yé.i dink, en 1908. do. p. 160.

Some facts concerning maize. Jl. of Agri. Victoria, VII. 5, May 1909, p. 193.

* Some people seem to think that because in many cases the villager only borrows his land (for a considerable rent) and his seed paddy, and because this is the "custom," that therefore he is not seriously in debt. He ought not to have to borrow seed, and he ought, if possible, to own the land.

Maize cultivation, Agr.Jl.of Victoria. do. p. 300.

Maize culture. Queensl. Agric. Journ. XXII. 5, May 1909, p. 220.

Corn Judging. do. p. 226.

Indian corn as a sugar producer, Louis. Pl.. 42, Feb. 1909, "T.A." Feb. 1910, p. 117.

Mango :—

The Mango. Woodrow.

Mangoes in Ceylon. Macmillan. "T.A." Aug. 1908, p. 135.

Exporting mangoes. Queensl. Ag. Jl., Nov. 1908, p. 219.

Rust on Mangoes. "T.A." Jan. 1909, p. 55.

Packing and Shipping of fruit. "T.A." Feb. 1909, p. 148.

Culture commerciale du Manguier. Journ. d'Agri. trop. June 1909, p. 174.

A Ripe rot of Mangoes. "T.A." Oct. 1909, p. 322.

The mango. H. H. Cousins. Phil. Agr. Review, II, 1909, p. 681.

Mangroves :

Report on mangrove bark from British Guiana. B. of Agri. Brit. Gui. 1, 1908, p. 72.

Bark of the red and white mangrove. Q. J. L'pool. I. C. R. Jan. 1908, p. 33.

On the white mangrove. do. p. 40.

Manila Hemp :—

Manila—en Sisal hemp of Java. H. C. P. Geerligs in Ind. Merc. 10, 11, 1908, p. 814.

Manila Hemp. Trin. Bull., Oct. 1908, p. 26.

Manila Hemp. Tropical Life. June 1909, p. 86, Contd. June p. 102.

Mate :—

Die Yerballes in Sud-Amerika und der Paraguaytee. Tropenpfl., Nov. 1907, p. 776.

Medicago :—

Lucerne or Alfalfa cultivation. Ag. Jl. India, Oct. 1909, p. 319.

Melaleuca :—

Baker and Smith, The Australian Melaleucas and their essential oils. Proc. Roy. Soc. N. S. W., Dec. 4, 1907, Bot. Centr. 108, p. 239.

Mimusops :—

Der Samen von Mimusops djave. Tropenpfl., Jan. 1910, p. 29.

Moringa :—

Huile de ben. Journ. d'Agr. trop., July 1906, p. 208.

Mulberry :—

Mulberry plantation. Ind. Agric., Nov. 1908, p. 352.

On the application of Bisulphide of Carbon in Mulberry culture. Journ. Col. of Agr., Tokyo., 1. 2, p. 185.

Myrobalans :—

Notes on *Terminalia Chebula* and its fruit, the myrobalan of commerce. Ind. Forester, Aug. 1907, p. 362.

Nipa :—

The Danni palm. Ind. Agr., Nov. 1907. "T.A." Feb. 1908, p. 138.

Nuts :—

Feeding value and flavour of Nuts. Ag. News, Oct. 1908, "T.A." May 1909, p. 457.

Nutmeg :—

Cultivation of the Nutmeg. "T.A." Sept. 1907, p. 46.

The fats of Indian Nutmegs. Agr. Led. V. P. Series 102, 1907. "T.A." Sept. 1008, p. 217.

Nymphæa :—

The seed of Nymphæa Lotus. Agr. Jl. Ind., Jan. 1908, "T.A." Sept. 1908, p. 243.

Oils :—

Composition of the oil seeds of India. Agr. News, June 1907, p. 203.

Oil of Bergamot. Chem. and Drug. 21. 9. 07, p. 457.

Le Karité, l'argan, &c. Trav. du lab. du mat. med, Paris, V. 198.

Sur l'huile de marrons d'Inde. do.

Graines et huile de Chaulmoogra. do.

Edible oil from Safflower seed (Carthamus tinctorius). "T.A." Jan. 1908, p. 41.

New Essential Oils. Trop. Life, June 1907, p. 86.

Philippine terpenes and essential oils. Phil. J. Sci. III. 49.

Some vegetable fats native to Sarawak. Str. Bull., May 1908, p. 173.

Argemone mexicana.—Agr. Ledg. V. P. Series 104, 1908.

Irvingia gabonensis. Q. J. L'pool. I. C. K. Jan. 1908, p. 20.

Carapa procera.—D. C. do. p. 21.

Poga oleosa.—Pierre do. p. 29.

Kernels of *Scypho cephalium Kombo*, Warts. do p. 32.

Geranium oil. Imp. Inst. Bull. 6, 1908, p 295.

New oil seeds from S. Nigeria. Trin. Bull., Oct. 1908, p. 48.

De cultuur der oliegrassen en de bereiding van hunne aetherische olien. Cultuurgids 10, I., p. 718.

Iets over olie-fabricates do. p. 751.

Cananga odorata. Bull. Economique. Jan.-Feb. 1909, p. 62.

Extraction of oil from seeds. Queensl. Agr. Jl. XXII. 5, p. 262, May 1909.

Die ölindustrie in India und Ceylon. Tropenpfl. Sept. 1909, p. 407.

Oils and Seeds. Imp. Inst. Report 1908. "T. A." Nov., p. 399.

Possibilities of Cotton seed oil. Ind. Agric. Sept. 1909. "T.A." Dec. p. 488.

Preservation of mixtures of Sesamum and groundnut oil. Ind. Trade Jl., Sept. 1909. "T.A." Dec. p. 489.

Le palmier a huile. Adam. Paris 1910.

CEYLON AGRICULTURAL SOCIETY.

MINUTES OF MEETING HELD ON 6th APRIL, 1910.

Minutes of the 51st Meeting of the Board of Agriculture, held at the Council Chamber, on Wednesday the 6th April, 1910, at 12 noon.

The Hon'ble Sir Hugh Clifford, K.C.M.G., Colonial Secretary, presided. There were also present:—The Hon'ble Messrs. H. L. Crawford, C.M.G., and A. Kanagasabai, Drs. J. C. Willis, H. M. Fernando, Messrs. P. Arunachalam, W. A. de Silva, G. W. Sturgess, C. J. C. Mee, Francis L. Daniel, J. D. Vanderstraaten, and C. Drieberg (Secretary).

The Minutes of the meeting held on 7th February, 1910, were read and confirmed.

Progress Report No. 49 was adopted.

Statements of Expenditure for February and March were laid on the table.

The motion *re* resolution adopted by the Bee Committee recommending the purchase of a machine for making foundation comb for *Apis Indica* bees was held over owing to the absence of Mr. E. E. Green in India.

Reports on the Tobacco Experiment at Maha-Iluppalama for February and March, by the Superintendent, were read by the Secretary.

Dr. Willis read his paper entitled "The Position of the Village Farmer." Mr. W. A. de Silva offered some remarks on the paper.

The Secretary read "A Note on the Basket and Mat-making Industry in Ceylon." After an inspection of mats and materials dealt with in the Note, the meeting terminated.

Mr. J. D. Vanderstraaten exhibited an interesting specimen of Travancore plantains of abnormal size raised by him at Negombo.

THE ADMINISTRATION OF AGRICULTURAL EDUCATION.

(From *Nature*, Vol. 81, No. 2084, Thursday, October 7, 1909.)

A memorandum has just been issued setting out the arrangements which have been made between the Board of Agriculture and the Board of Education in regard to agricultural education. It has been known for some time that a certain amount of controversy existed between the two departments on account of the anomaly arising from the fact that the Board of Agriculture inspected and gave grants to the various agricultural colleges and other institutions for higher agricultural education, whereas agricultural instruction in secondary and primary schools, like all other forms of education, was controlled by the Board of Education. On the one hand it was felt that agricultural education could not thus be dissociated from the general system of the country; on the other hand, there was the danger that so special, and in many respects so weakly supported, a subject would never receive the attention it deserved without the fostering care of its own special department. The situation became more critical as it appeared that the Board of Agriculture, however anxious to retain its connection with the colleges, was unable to obtain the funds either to make adequate grants to existing institutions or to promote the creation of fresh colleges where they were needed. The two Boards appear now to have arrived at a compromise which still leaves the higher educational institutions under the charge of the Board of Agriculture, but also secures an interchange of views by the creation of an interdepartmental committee. The Board of Agriculture is to take charge of advanced schools of agriculture serving, as a rule, more than one local education authority's area, and taking students of an age of seventeen and upwards; under its charge also will

be such special institutions as deal only with one branch of agricultural instruction, as dairying, forestry, &c. As before, the Board of Education will be in charge of the agricultural instruction that is provided by the county councils and other local educational authorities, but it is not clear by which Board, or in what way, pressure can be brought to bear upon the backward counties that are now doing nothing for organised agricultural education. For example, the East Sussex County Council uses part of its "whisky money" to maintain an agricultural college, which is further assisted by grants from the Board of Agriculture, the West Sussex County Council next door puts the whisky money to the relief of rats, and does nothing for agricultural education. The defect in the Board of Agriculture's administration has been the fact that it has been powerless in such cases; it could neither compel nor bribe such counties to do their duty, and what the public interested in such matters is anxious to know is how the new arrangement will be worked to ensure a provision of higher agricultural education for farmers in all parts of the country, a national system that is not dependent on the caprice or the poverty of any county council.

The novel feature in the memorandum besides the Inter-Departmental Committee is a proposal to create a Rural Education Conference, consisting of representatives of the County Councils' Association, the Agricultural Education Association, and other agricultural organisations, with certain officers of the two Boards. Such a consultative committee seems to smack of the Board of Agriculture's favourite attitude of asking the farmers what it can do for them, but perhaps the influence of the Board of Education, which takes a less humble view of its own expert qualifications and powers to give a lead, will supply the stiffening and find a means of translating the suggestions of the conference into practice.

SOUTHERN AGRICULTURE.

By F. S. Earle.

(From *Science*, Vol. XXIX., No. 731, January 1, 1909.)

This work has many points of merit to commend it to the schools of the south, and will no doubt be widely used as a text-book. It is divided into two parts, the first dealing with general considerations, such as climate, soil, soil management, soil improvement, the growth of plants, insects and diseases, and closes with a chapter on farm policy and management. The second part treats of the chief southern agricultural crops, including grasses and forage crops, fibre crops, tobacco, coffee, fruits, nut crops and forestry, and closes with a short chapter on domestic animals.

In the chapter on management of the soil, valuable suggestions are given on the use of farm implements, a part of agriculture so often neglected by writers. A little farther on, soil improvement is well treated and the relation of leguminous crops to same, with recommendations of certain leguminous crops for certain kinds of soil. The student is shown the relation of the plant to the soil, and the functions of the different parts of plants. The chapter on spraying and sprays, containing formulæ for different sprays, is well arranged and almost indispensable, inasmuch as crop enemies, such as insects and fungi are so rapidly increasing in the south where heat and moisture are so conducive to their welfare.

In treating of individual crops in the second part of the book, the method is to be commended. First, the author deals with the crop itself, and then as far as consistent with the nature of the plant, takes up a detailed study in each individual crop, of soil and climate, manuring, methods of planting and cultivating, and harvesting. This uniformity of method gives the pupil the benefit of comparing one crop with another on any of these points suggested.

Just what is meant by southern agriculture is not suggested by the author, but from the numerous references to the tropics and the tropical agriculture, it would seem that they are included in the title of the book. Possibly it would have been better to have gone a little further into the general and specific methods of tropical agriculture, and have given the book the title "Southern and Tropical Agriculture."

There seems to be very little excuse for devoting twenty-four pages to sugar-cane and only sixteen to cotton, when the author states that cotton is our "greatest commercial crop," also, only twelve to corn, "the most important crop." A little more space should have been devoted to the best methods of improving cotton and corn, if not any less to sugar cane, especially after the above statements. The space devoted to an explanation of the poor methods of cotton planting on page 175 and 176

could have been better used by giving better methods and emphasizing the necessity for level cultivation of cotton. It is a better paying business, for instance, to lay off new rows for your cotton than to follow cotton after cotton, as suggested in the text, notwithstanding the fact that its danger is hinted at on the same page.

There is no chapter devoted to the dairy and live-stock industry, though the importance of it is suggested in three places in the book. Stock feed can be raised very cheaply in the south, and the cost of keeping stock is reduced to the minimum. No costly shelters are required, and it is possible to arrange your pastures so that your stock can graze ten or eleven months in the year. Besides, at present, we ship from the south millions of dollars' worth of cotton-seed meal annually, to be used for stock feed in other parts of the world, instead of using it as we should, first through live-stock to increase the beef and butter production of the south; and, secondly, in the form of barnyard manure to fertilize the land with. It is believed that the book would have been worth more to the schools of the south, if a good, lengthy chapter on the live-stock industry had been included.

In conclusion, it seems that the author is more at home in his studies of tropical agriculture, and though he has done excellent work, many parts of the book read as if the information given were not first hand. For instance, there is a freshness and an air of confidence in those parts that treat of diseases and remedies, and the botanical features of special crops that are conspicuously lacking in the parts devoted to manuring and cultivating.

PERADENIYA EXPERIMENT STATION.

Minutes of a meeting of the Committee of Agricultural Experiments held at the Experiment Station, Peradeniya, on 10th March, 1910.

The following members were present:— Dr. Willis, Chairman, the Entomologist, the Mycologist, the Government Chemist, the Hon'ble Mr. E. Turner, the Hon'ble the Government Agent, C. P., the Secretary, and Messrs. Rosling, Jowitt, Lock and Vanderstraaten.

The Secretary read the Progress Report since the previous meeting, and the following resolutions were passed:—

1. That the question of obtaining a better breed of cattle and providing more up-to-date accommodation for the same, with a view to making manure on the most approved methods, should be set down for consideration at the first meeting of 1911.
2. That the coconut land suggested be cleared for fruit experiments.
3. That 2,000 coconuts be set aside and used for oil and copra experiments in lots of 500—500 being at once used and the remainder being used at intervals of one month.

J. A. HOLMES,
Secretary, C. A. E., and Superintendent,

Experiment Station, Peradeniya.
12th March, 1910.

PROGRESS REPORT ON EXPERIMENT STATION SINCE MEETING ON 13TH JANUARY, 1910.

TEA.—The usual cultivation has been done and the Crotalaria in plot 148 has been cut and mulched, that sown in 147 has had its stems bent to cause it to grow low on the surface of the ground.

The Indigofera in plot 142 has also been cut and mulched.

The steep slopes on plots 154 and 155 have been manured and trenched as the bushes are very poor.

The yield since last meeting has been good, about 5,500 lbs. green tea having been despatched to Peradeniya.

CACAO.—The dadaps on the five acres of young cacao have been pruned in various ways, two plots having had the stems bent over, and two each having been topped to form high and low shade respectively. The young plants in the plots sown with Indigofera and Crotalaria have died back considerably since these latter were cut.

Owing to the absence of drains these plots have suffered considerably from wash, but drains have been traced and will be cut as soon as labour is available.

The paths dividing plots 1-10 and 107-111 have also been cleared.

Owing to density of shade and close planting, the abandoned cacao plots are in a very poor condition.

10,372 lbs. have been shipped to London.

COCONUTS.—In one acre of coconuts the trees have been forked round to a distance of 10 feet and mulched with green jungle stuff, and cattle are being tied at night to the trees on another division,

Owing to the fact that, in order to cultivate by machinery, the ten acres of young nuts have been left undrained, many of the holes were completely filled in by wash on February 19th, and in consequence about seventy-seven supplies are now required.

Two experiments in oil expression have been tried, one from freshly-picked nuts and the other from nuts which had been stored for one month, with the following results :—

	Fresh nuts.	Old nuts.
Nuts ...	5 cwts	5 cwt. 1 qr. 23
Copra ...	160 lbs.	183½ lbs.
Oil ...	83 ,,	102¼ ,,
Poonac ...	55 ,,	65¾ ,,

Rubber (Para).—The majority of the para trees are now getting their young leaves, although a few have still to lose their old ones ; some of the trees are also seeding.

Tapping has been stopped as the yields did not justify its continuation, but will be again resumed as soon as the trees have attained their full foliage.

Monthly measurements have been made of the girths, the variation from one month to another in most cases being inappreciable.

Some slight damage has been caused to those trees, which were thumb-nail pruned, by wind—one tree having been broken off about 7 feet from the ground and a few others splitting, thus losing branches.

Some 250 selected seed were obtained from Kondesalle, and so far about 62 have germinated.

Plots 77-82 have been drained.

Ceara.—Ceara is now wintering and tapping has been stopped. An order for 100,000 selected seed having been received, those trees which promised to give less than 1 lb. of dry rubber per annum have all been cut out.

Seeds of good yielding varieties from Mr. Gaddum, Gampola, and from Travancore have been planted out.

A good deal of interest is being shown by planters in the perpendicular method of tapping.

Heptaphylla.—Five hundred seeds have been planted in nurseries.

Manihot have again suffered from wind, except in the 6 × 6 plot and in plot 25 where the branches were topped.

Castilloa are now wintering, plot 97 has been tapped with a full spiral cut, the yields on the first tapping being good, but subsequent tappings unsatisfactory.

Plots 125-129 have been drained.

Funtumia and Piauhyensis.—These plots have been drained.

Paddy.—The paddy which was somewhat layered by rain and pig has been cut, the weights were :—

	Transplanted.		Sown Broadcast.	
	Manured.	Unmanured.	Manured.	Unmanured.
Paddy	25¼ bush.	13⅞ bush.	15¾ bush.	12⅞ bush.
Straw	1,327 lb.	1,368 lb.	859 lb.	1,056 lb.

Oil Grasses.—The still has been working from time to time and a shipment of two dozen bottles lemon grass oil will shortly be made ; the present price of the oil is 8d. per oz.

214 lbs. Lena Batu Pengiri gave 332 ccs. of oil. A large plot of Maha Pengiri has been planted out and a sufficient amount of *Cymbopogon martini* has grown to plant a 1-100th acre bed.

Cymbopogon confertifolius was cut and weighed 202 lb. but was insufficiently distilled.

Fruits.—Some Kew and Mauritius pines have been planted.

The Plantains have been supplied and drained.

Nurseries.—Para, heptaphylla, and Ceara seeds have been sown, also Dumbara tobacco and Sesbania aculeata, and green manure from India.

Green Manure.—*Tephrosia candida* cut and mulched and weighed 332 lb. = 33,200 lb per acre ; it is again sprouting satisfactorily.

Ipomea cut weighed 56 lbs.

Crotalaria incana which had been attacked by Necrosperma vasinfecta was dug up and thrown away, a new bed being planted in a different site, a non-leguminous plant being put in its original bed.

A bed of *Leucæna glauca*, a leguminous shade tree largely used by coffee planters in Java, has been sown.

Mimosa pudica was cut and mulched, and weighed 65 lb.

Wash Plots.—Loss from April, 1909, to March, 1910 :—

Desmodium	605¾	Albizzia	3,631¾
Mixed Crotalaria	1,411	Crotalaria across slope	1,395
Dadap	5,810¼	Deep forking	5,168
Bare weeded	5,858½	Ipomea	2,235
Crotalaria incana	2,665¼		

Stumps.—About forty large stumps have been removed with the help of the extractor.

Visitors.—132 visitors, planters and otherwise, have been conducted around the Station.

THE RELATION OF SCHOOL GARDENS TO NATURE STUDY.

BY MISS FANNIE A. STEBBINS,
Supervisor of Nature Study, Springfield, Mass.

(From the *Transactions of Mass. Horticultural Society for the year* 1907, Pt. II.)

If we take as a statement of the object of Nature Study that it is to cultivate in the child an intelligent interest in the world about him, the question of the relation of the school garden to Nature Study is simplified.

We wish the child to form the habit of observing, as correctly as may be, series of facts, noting relations of cause and effect and drawing conclusions from the facts observed; then carrying the work further by working out theories which he may prove or disprove.

For the establishment of many facts the school garden is the best possible laboratory or workshop. The individual plot supplies the added incentive of the feeling of personal ownership and responsibility; and where it is possible to have individual plots they should be used. The child sees more clearly his own relation to the plant's growth, or lack of it, and feels more keenly the need of care and of knowledge to precede that care. Under proper guidance and conduct of class plots the pupils may be stimulated to repeat the experiments at home, as is frequently done, where conditions a little different produce different results, and comparisons of such results may be made extremely valuable. So even if land be limited much may be accomplished by observation plots.

One line of work that ought to be carried out is the cultivation of many of our most common commercial products which are considered in geography, but which are only names to the majority of the pupils. Some of the grains—wheat, corn, rye, oats, buckwheat, barley, etc.—can be easily grown. Hemp and flax together with some of the less common products which the U. S. Department of Agriculture is introducing could well be observed.

In one of our schools flax grown by the children was soaked, and by the janitor, who had done the work in Ireland, worked or treated until the fibre was ready for spinning. A valuable lesson or series of lessons.

Another phase is the gathering and growing of many of our formerly common wild flowers which are fast disappearing from the neighbourhood of cities, and are seldom seen by the children. Many valuable lessons can be learned by watching the plant through its year of life; how it breaks through the soil; how parts are protected, each part fitted for its duties; the blooming, with interesting peculiarities, formation, protection, and dissemination of seeds; preparation for winter, etc. So the child becomes acquainted with the plant as he almost never does in its home without.

The production of plants can best be studied in the yard where the class can be taken at any time; sowing the seeds, the best manner for individual kinds; layering; budding; grafting; and with the latter the study of where the sap comes; rings of growth where new wood comes; real meaning of a bud, whether flower or branch bud; need of keeping out fungi; etc.; incidentally how and when to trim a tree; to treat wounds, etc. With the coming of the flowers, the visits of insects, cross-pollination, self-pollination or no pollination, hybridization, crossing squash and lemon, etc., can be observed. As the cutworms or other insects come, the suggestion of studying their life histories becomes a vital question that the best means may be discovered of combating these enemies in the most vulnerable stage of their existence. Caterpillars which are injurious may in their butterflyhood do some good and so help balance accounts. Ichneumon flies which parasite pests may be recognized as helpers. And of course our friend, the toad, should be watched, both indoors where more accurate observations can be made of amount of food, etc., and outside where one should be established in the garden if possible and treated as a friend. The garden may give opportunity to recognize birds among our friends.

The study of soils receives new meaning when the effect of different kinds upon the growth of plants is observed. In this connection the study of capillary attraction receives reinforcement in observing the work of a mulch. This broadens out into the study of the soil of the forest, its influence in the retention of water, the desirability of forests at the head waters of rivers, and the need of reforesting cut areas.

And so one could go on multiplying instance after instance where principles observed in one connection receive their application in another connection and so make deeper and broader impression on the child's mind. He comes to see

more and more of the inter-relation of all things, our dependence upon the life about us, and our need of studying the laws underlying all, that we may bring under control those forces which aid in our better living.

In a word, then, I would characterize the school garden as a laboratory in which can be worked out many problems, under control, and in a comparatively short time, the answers to which are necessary to an intelligent comprehension of the great world about us; and the child's desire to make plants grow furnishes a keen incentive to such experimentation.

Correspondence.

TAPPING OF LANDOLPHIA.

London, E.C., 6th October, 1909.

DEAR SIR,—I am greatly interested in a Landolphia Plantation, and I am advised, in view of labour difficulties, that the best means of handling same is to cut it three feet from the ground, remove the bark from the cut portion, and by means of a Decorticating machine obtain the rubber, which I am told is better and cleaner than tapped rubber.

I am informed that the cut portion will grow again, and that Hevea and other trees can be grafted on to the stumps. Is that so?

Are there any plantations where Landolphia is being cut and is growing again, or where other trees have been grafted on to the stumps, or where the decortication of Landolphia has been a commercial success?

I shall be glad to have a copy of your paper containing your reply, together with particulars of subscription.

Thanking you in anticipation,

I am, yours faithfully,

for S. G.,

W. A. H.

[1. I have never heard of Landolphia being cut down as stated and the rubber extracted with a decorticating machine.

2. Experiments in this direction have so far been failures, except perhaps for Guayule extraction and Gutta from Gutta Percha leaves.

3. The stumps might grow again, but the barked stems would certainly not.

4. The idea of grafting Hevea or other rubber trees on to the stumps is absurd.

5. There are no plantations of Landolphia, which is essentially a forest product and requires large forest trees to grow upon.—M. K. BAMBER, *Government Chemist.*]

SESAMUM CULTIVATION.

Melbourne, 24th February, 1910.

DEAR SIR,—Having a Plantation in Papua, and being anxious to experiment with the growing of Sesame Seed, I am writing to ask you if you can furnish any information regarding this. I have no idea how it is grown or harvested, and can find no books dealing with the question. Perhaps, if you would kindly publish this, some of your readers would be able to supply the information.

I might state that I am a regular subscriber to your Journal, and am able to glean much valuable information from it.

Yours, &c.,

PAPUAN PLANTER.

[Full information can be found in Watt's Dictionary of Economic Products of India, and articles on Indian Sesamum in "Indian Agriculturist" for February, 1907, and on Sesamum in Burma in same Journal for January, 1908. In Ceylon it is generally a dry-season crop, grown with the April rains in the dry country. The ground is scratched over and sown. There is no rain from May to September and the crop is reaped before the next rains come.—EDITOR *T.A.*]

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Monthly Prices Current, London, 16th March, 1910.)

	QUALITY.	QUOTATIONS.
ALOES, Socotrine cwt.	Fair to fine ...	80s a 85s
Zanzibar & Hepatic ,,	Common to good ..	40s a 70s
ARROWROOT (Natal) lb.	Fair to fine ..	7d a 8d
BEES' WAX, cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair ...	£6 12s 6d a £6 15s
Bombay bleached ,,	Fair to good	£7 10s a £7 12s 6d
,, unbleached ,,	Dark to good genuine ..	£5 15s a £6 10s
Madagascar ,,	Dark to good palish	£6 12s6d a £6 17/6
CAMPHOR, Japan ,,	Refined	1s 5¾d a 1s 7d
China ,,	Fair average quality ...	136s
CARDAMOMS, Tuticorin	Good to fine bold	2s a 2s 5d
	Middling lean	1s 9d a 1s 10d
Tellicherry	Good to fine bold ..	2s a 2s 3d
	Brownish .	1s 6d a 1s 9d
Mangalore ,,	Med brown to fair bold	1s 10d a 2s 8d
Ceylon. Mysore ,,	Small fair to fine plump	1s 4d a 3s
Malabar ..	Fair to good ..	1s 2d a 1s 4d
Seeds, E. I. & Ceylon ,,	Fair to good ..	1s 7d a 1s 8d
Ceylon Long Wild ,,	Shelly to good ..	6d a 1s 7d
CASTOR OIL, Calcutta ,,	Good 2nds ..	3⅜d a 3 1-16d
CHILLIES, Zanzibar cwt.	Dull to fine bright ...	4 s a 45s
CINCHONA BARK.—lb.		
Ceylon	Crown, Renewed	3⅜d a 7d
	Org. Stem	2d a 6d
	Red Org. Stem	1⅜d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts per lb.	Good to fine quill	6½d a 1s 5d
2nds	,, ,,	5¾d a 1s 4d
3rds	,, ,,	5d a 1s
4ths	,, ,,	4½d a 8½d
Chips, &c..	Fair to fine bold	2¼d a 3d
CLOVES, Penang lb.	Dull to fine bright pkd.	1d 5s a 1s 6d
Amboyna ..	Dull to fine	9d a 10d
Ceylon ..	,, ,,	9d a 10d
Zanzibar	Fair and fine bright	5½d a 5¾d
Stems ..	Fair	2¼d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	65d a 100s
Native	Good ordinary	nominal
Liberian ,,	Fair to bold	43s a 55s
COCOA, Ceylon Plant. ,,	Special Marks	62s a 69s
	Red to good	54s a 60s 6d
Native Estate ,,	Ordinary to red	39s a 56s
Java and Celebes ,,	Small to good red	30s a 85s
COLOMBO ROOT ,,	Middling to good	30s a 35s
CROTON SEEDS, sift. cwt.	Dull to fair	47s 6d a 50s
CUBEBS ,, ,,	Ord. stalky to good	110s a 120s
GINGER, Bengal, rough,,	Fair	40s nom.
Calicut, Cut A ,,	Small to fine bold	65s a 85s
B & C ,,	Small and medium	55s a 60s
Cochin Rough ,,	Common to fine bold	45s a 50s
	Small and D's	42s 6d a 45
Japan ,,	Unsplit	43s
GUM AMMONIACUM ,,	Sm. blocky to fair clean	35s a 73s 6d
ANIMI, Zanzibar	Pale and amber, str. srts.	£16 a £18 5s
	,, ,, little red	£18 a £15
	Bean and Pea size ditto	75s a £14 2s 6d
	Fair to good red sorts	£9 a £13 10s
	Med. & bold glassy sorts	£6 a £[illegible]
Madagascar ,,	Fair to good palish ...	£4 a £8 15s
	,, ,, red ...	£4 a £7 10s
ARABIC E. I. & Aden ,,	Ordinary to good pale	25s a 32s 6d nom.
Turkey sorts ,,		3 s a 47s 6d
Ghatti ,,	Sorts to fine pale ...	20s a 42s 6d nom.
Kurrachee ,,	Reddish to good pale ...	20s a 30s ,,
Madras ,,	Dark to fine pale ..	15s a 25s ,,
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£9 £10 10s
	com. stony to good block	15s a £8
KINO	Fair to fine bright	6d a 9d
MYRRH, Aden sorts cwt	Middling to good	60s a 70s
Somali ,,	,, ,,	55s a 60s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
	Middling to fair	30s a 40s
pickings ,,	Low to good pale	10s a 25s 6d
siftings ,,	Slightly foul to fine	13s a 16s
INDIA RUBBER lb.	Fine Para bis. & sheets	10s 7d
	,, Ceara ,, ,,	10s
Ceylon, Straits, Malay Straits, etc.	Crepe ordinary to fine..	10s 3d a 10s 9d
	Fine Block ..	10s 10d
	Scrap fair to fine ..	8s a 8s 9d
Assam	Plantation ..	6s 8d a 7s
	Fair II to ord. red No. 1	5s a 6s 4d
Rangoon	,, ,,	3s 6d a 4s 2d

	QUALITY.	QUOTATIONS.
INDIARUBBER. *(Contd.)*		
Borneo	Common to good	2s 8d a 3s 9d
Java	Good to fine red	3s 6d a 4s 10d
Penang	Low white to prime red	2s 9d a 3s 8d
Mozambique	Fair to fine red ball ...	6s 3d a 7s
	Sausage, fair to good ..	6s 1d a 6s 10d
Nyassaland	Fair to fine ball ...	5s 3d a 6s 4d
Madagascar	Fr to fine pinky & white	3s 9d a 4s 6d
	Majunga & blk coated ..	3s a 3s 8d
	Niggers, low to good ..	1s 6d a 4s
New Guinea	Ordinary to fine ball ..	3s 2d a 4s 2d nom
INDIGO, E.I. Bengal	Shipping mid to gd violet	2s 10d a 3s 8d
	Consuming mid. to gd.	2s 6d a 2s 10d
	Ordinary to middling	2s 2d a 2s 5d
	Oudes Middling to fine	2s 6d a 2/8 nom.
	Mid. to good Kurpah	2s 2d a 2s 6d
	Low to ordinary	1s 6d a 2s
	Mid. to fine Madras	1s 5d a 2s 4d
MACE, Bombay & Penang	Pale reddish to fine	1s 11d a 2s 4d
per lb.	Ordinary to fair	1s 8d a 1s 10d
Java	,, ,, good pale	1s 7d a 2s
Bombay	Wild	4d a 4½d
MYRABOLANES, cwt	UG and Coconada	5s a 5s 6d
Bombay ,,	Jubblepore	5s a 6s
	Bhimlies	5s 3d a 6s 6d
	Rhajpore, &c.	4s 9d a 5s 6d
Bengal ,,	Calcutta	5s 6d a 6s
NUTMEGS— lb.	64's to 57's	1s a 1s 6d
Bombay & Penang ,,	110's to 65's	4¾d a 1s
	160's to 115's	4d a 4½d
NUTS, ARECA cwt.	Ordinary to fair fresh	14s a 15s
NUX VOMICA, Cochin	Ordinary to good	9s a 11s 6d
per cwt. Bengal	,, ,,	6s 6d a 7d
Madras	,, ,,	6s 9d a 8s
OIL OF ANISEED ,,	Fair merchantable	4s 6d
CASSIA ,,	According to analysis	3s 6d a 3s 10d
LEMONGRASS ,,	Good flavour & colour	2¾d a 3d
NUTMEG ,,	Dingy to white	1½d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	2d a 1s
CITRONELLE ,,	Bright & good flavour	1s
ORCHELLA WEED—cwt		
Ceylon ,,	Mid. to fine not woody...	8s a 10s
Madagascar ,,	Fair ...	8s
PEPPER– (Black) lb.		
Alleppee & Tellicherry	Fair ...	3⅞d
Ceylon	,, to fine bold heavy ..	3⅞d a 4⅛d
Singapore ...	,, ...	4d
Acheen & W. C. Penang	Dull to fine	3½d 3¾d
(White) Singapore ,,	Fair to fine	6⅞d a 8d
Siam ,,	Fair	6⅞d
Penang ,,	Fair	6½d
Muntok ,,	Fair	7¼d
RHUBARB, Shenzi ..	Ordinary to good ...	1s 3d a 2s 8d
Canton ..	Ordinary to good ..	11d a 1s 2d
High Dried..	Good to fine flat ..	10½s a 1s
	Dark to fair round ..	5d a 6½d
SAGO, Pearl, large ...	Dull to fine	20s a 22s
medium ..	,, ,,	16s a 17s 6d
small ...	,, ,,	16s a 17s 6d
SEEDLAC cwt.	Ordinary to gd. soluble	45s a 60s
SENNA, Tinnevelly lb.	Good to fine bold green	4½d a 7d
	Fair greenish	2¼d a 4½d
	Common specky and small	1⅝d a 2¼d
SHELLS, M. o'PEARL—		
Egyptian cwt.	Small to bold ..	27s a 135s
Bombay ,,	,, ..	18s a 127/6 nom.
Mergui ,,	,, ,, ...	£ 5s a £9 7s 6d
Manilla ,,	Fair to good ..	£7 10s a £10 15s
Banda ,,	Sorts	25s a 30s nom
TAMARINDS, Calcutta..	Mid. to fine bl'k not stony	11s a 12s 6d
per cwt. Madras	Stony and inferior ..	4s a 5s
TORTOISESHELL—		
Zanzibar, & Bombay lb.	Small to bold ..	11s a 29s
	Pickings ..	8s a 23s
TURMERIC, Bengal cwt.	Fair .	17s 6d
Madras ,,	Finger fair to fine bold [bright	23s a 24s 6d
Do. ,,	Bulbs	17s a 18s
Cochin ,,	Finger ..	20s
	Bulbs ...	14s 6d
VANILLOES— lb.		
Mauritius .. } 1sts	Gd crystallized 3½ a 8½ in	12s a 18s
Madagascar .. } 2nds	Foxy & reddish 3½ a ,,	11s a 14s
Seychelles } 3rds	Lean and inferior ...	11s a 11s 6d
VERMILLION ..	Fine, pure, bright	3s 3d
WAX, Japan, squares	Good white hard ...	41s

THE SUPPLEMENT TO THE

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COMPILED AND EDITED BY A. M. & J. FERGUSON.

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OBSCURE CAUSES OF UNPRODUCTIVENESS IN LAND.

The occurrence of bare or unthrifty patches in cultivated land often proves as much a source of vexation as a cause for speculation, and it is seldom that any satisfactory explanation of them can be given. This matter has received the attention of the Chemical Branch of the New South Wales Department of Agriculture and the contribution by Mr. Lionel Cohen to the "Agricultural Gazette" of that Colony is full of interest and instruction. A fact that tends to make the study of the question more confusing than otherwise is that the soil of these patches is generally found by the chemist to be as well supplied with plant food as the rest of the land. It is to be inferred, therefore, that the unproductiveness of the soil in the areas referred to must be due to the presence of somo deleterious substance inimical to plant life. Such substances as carbonate of soda, sulphate of soda and common salt are well known to render land, particularly in arid areas, unfertile; but these familiar causes of barrenness can in most cases be removed by judicious treatment, e.g., drainage, irrigation and cropping. Other substances which have a similar action are the lowor oxides and the sulphides of iron, as well as an excess of magnesia over lime. Still other factors of infertility are the toxic compounds of organic origin, which have of late received considerable attention both in America and England. Mr. Cohen has in his experience come across patches of soil with a large percentage of manganese, while only the merest traces were found in the rest of the land; and yet the soil on the patches was richer in plant food than the surrounding land. Mr. W. P. Kelly, of the Hawaii Experiment Station, records the failure of a soil to grow pineapples owing to an excess of manganese, though sugarcane grew luxuriantly ou the same soil. It would appear that certain plants are peculiarly sensitive to the presence of certain substances in the soil: for instance, Barley to manganese, while others, such as oats, sorghum and maize, are not so sensitive. Here then are further considerations for the agriculturist to ponder over, and for the chemist to weigh, for it would appear that not only must we know the proportions of plant food in the soil, but also ascertain to what extent undesirable compounds (according to the idiosyncrasies of plants) are present in it. They also point to the necessity for carefully selecting crops suitable to particular conditions of soil. The occurrence of unproductive tracts have also been traced to too large a perceutage of calcium chloride and potassium chloride. In this connection might be quoted Dr. Aikman's recommendation that sulphate of potash is preferable to chloride of potash as a manure, for the reason that the chloride is liable to give rise to calcium chloride "a compound distinctly harmful to many plants." According to Kuhn when ammonium chloride is applied to a soil the tendency is for the ammonia to be assimilated and the chloride to form hydro-chloric acid to such au extent as to provo fatal to plants. At the Woburn Experimental Farm (England) the continued use of ammonium-salts (sulphate and chloride) has brought about an acid condition resulting in complete sterility, which, however, could be neutralised by the application of time. It may thus happen that manuring with chemical manures may actually result in harm if their action and reaction are not fully understood. All this shows how complex is the scienco of agriculture and how much light can be thrown upon the subject by the labours of the working scientist.

YIELD OF COCONUTS PER TREE.

"A good Coconut tree" says the *Porto Rico Horticultural News*, "should yield an average of one hundred nuts per year, and under favourable conditions two hundred have been obtained. Taking the whole island of Porto Rico, however, a return of sixty-five nuts per tree is probably about the average figure obtained, and no doubt conditions are very similar in the British West Indian islands."

A Colombo correspondent informs us that he had a tree plucked about two years ago which gave 127 nuts at the one plucking, while we read not long ago of a tree on Klanang Estate in the F.M.S. which had 360 nuts upon it. Not only was this latter tree literally loaded with large nuts but a number of small ones were to be seen on it in the earlier stages of development. The tree was by no means a large one and was only about eleven years old.

A good average yield per tree on an average coconut plantation in Ceylon is 30 to 40 nuts.

THE CEYLON RUBBER INDUSTRY.

Mr. Alex. Fairlie's Views.

Mr. Alex. Fairlie, head of the firm of Messrs. Jas. Finlay & Co., Limited, and ex-Chairman of Ceylon Chamber of Commerce, who left for home last month, spent his last few days in Ceylon in a visit to rubber estates in the Pelmadulla district. This completed a series of motor car trips Mr. Fairlie had taken recently, visiting estates in which his firm are interested. His journeyings took him through some of the best known rubber centres in Ceylon—Kelani Valley, Kalutara, Maddagedera and Sabaragamuwa Province—and as a result of his observations Mr Fairlie left Ceylon more deeply convinced than ever of the extreme soundness, agriculturally, of the rubber industry and of its splendid progress in Ceylon.

Speaking of Pelmadulla district Mr Fairlie told our representative that the development in that district was most remarkable. Great expanses of virgin forest had been cleared and thousands of acres of rubber now flourished there from 4½ years downwards. The rubber grew splendidly, the best of it being very fine. He saw no bad rubber nor heard of any form of disease. Labour was quite ample for the requirements of the district. Clean weeding was adopted on all the estates and all the estates were clean. "As a matter of fact," said Mr Fairlie, "I consider the future of rubber in this fine district absolutely assured and sound."

Mr. Fairlie is inclined generally to take a very bright view of the rubber industry agriculturally.

"What about labour in the future?"

"I do not anticipate serious trouble. A half cooly per acre will be sufficient to start tapping with, but as the trees begin to yield increased quantities of latex that number may have to be increased. I believe the demand will be met."

"And what is the cost of production to work out at when large areas come into bearing?"

"The cost of production is ultimately going to be under 50 cents per lb., including everything—that is, of course, when we get large blocks of rubber in bearing."

COFFEE ROBUSTA AS A CATCH-CROP IN PARA RUBBER AND COCONUTS.

Bulletin No. 7 issued by the Department of Agriculture, Federated Malay States, is on Coffee Robusta by W J Gallagher, M.A., Director of Agriculture, F. M. S. The concluding paragraph is as follows :—

Many of our soils, especially on hard-backed steep hills, are not over fertile, and it is probable that it is the best in the long run to bring rubber into bearing without catch-crops, which all compete with the principal crop and remove a certain amount of available plant food. But many private owners, small syndicates, and even companies cannot wait five years for a return. A desirable catch-crop should be a crop yielding a good profit; it should not be too severe on the soil; it should bear early; it should admit of weeding so as to leave the land in a clean condition when it is taken out.

Tapioca has been tried and is hardly a success. In fact it is quite undesirable. Apart from the possibility at present prices of its yielding a very small profit, if any, it is so difficult to weed that a large amount of lalang gets in and the land is in a decidedly dirty condition when the crop is removed. Camphor allows the land to be kept clean, but the time to wait for a crop is too long and then the profit is not much. Coffee robusta offers by far the best catch-crop. A small return will come in the second year and a good one in the third and following years.

Therefore for those who must put down a catch-crop it is undoubtedly the best. The production of robusta costs less per picul than liberica. The total cost of production should not exceed $12/- a picul, which returns a profit of $6/- a picul on an average price of $18/- a picul. Planted as a catch-crop in the way already recommended, *i. e.*, about 1,000 to the acre, a return of 10 piculs of market coffee ought to be obtained by the end of the fifth year. This would yield a profit of $60/- or over $130/- at present prices.

These figures are conservative, judging by the example already given from Java. In the F.M.S. we have not sufficient data on which to base close estimates; but it is evident that if the entire capital cost of the rubber cannot be recovered, at least from the end of the second year it can be more than upkept from the profits on robusta.

It must be remembered that the cost of planting the coffee has to be added to the cost of bringing the rubber into bearing, but on the other hand owing to the earlier shade the weeding will cost less than in para alone.

When rubber has been interplanted in liberica it is a common fault to let the coffee practically die out. This should be guarded against when the time comes to deal with robusta. Large robusta of five years old will compete seriously with para. The robusta should be ruthlessly cut out as soon as the branches of the rubber trees meet and certainly in the beginning of the sixth year.

ACCACIA DECURRENS.

RESULTS WANTED.

Pykara Falls Estate, Naduvatam,
Nilgiris, Jan. 19th.

SIR,—You must be aware that a very important departure has been made by Upcountry tea Planters in Ceylon, at elevation over 3,000 ft., in planting *Acacia decurrens* throughout their fields of tea as a green manure and, therefore, I venture to suggest that you should kindly ascertain what the results have been up to date, and enlighten your general readers on this subject. *Acacia decurrens* has an enormous development of roots, and how the interference of these roots with the roots of the tea bushes is prevented is a very important question to tea planters. Will you kindly enquire into this matter at an early date.—Yours faithfully,

A. PETER.

We invite atttention to the above interesting enquiry sent us by a Nilgiris planter, as to the results of the planting of *Accacia decurrens*, in so far as it acts as green manure amongst tea. The results are probably much easier to indicate in general terms, from managers' experience of improvement of the tea bushes and variously increased yields. But to state at all accurately how much in at all concrete terms, the trees have served as green manures, may be a matter of some difficulty. Will any particular planter kindly send us an up-to-date account of their results for the benefit of local as well as South Indian readers?

FERTILISERS ON RUBBER PLANTATIONS.

Jan. 7.—The time has arrived in the sub-tropical Colonies to begin the advantageous use of fertilisers for rubber plantations.

Mr. John Hughes wrote to me, the other day, asking,—

Can you tell me how the Government rubber plantations have turned out, namely:—

1. The younger plantation at Henaratgoda.
2. Culloden 60-acre field.
3. Apatipawnura Flood-level, Forest Department, Ratnapura.
4. Edangoda.

You may remember that I analysed samples of those sent me in September, 1898, and the results were published subsequently, after delay, by Dr. Willis.

I answered Mr. Hughes about the Government clearings—sold not very long ago—apart, of course, from the Heneratgoda Garden with the older Para trees in the island. Culloden "rubber" has done well for its fortunate owners, and it is interesting to hear further from Mr. Hughes:—

London, E.C., January 5th, 1910.—Thanks for your prompt reply. The names mentioned were those on the boxes as sent me. It is interesting to note that in my remarks entered in analysis book as long since as Sept. 15th, 1898, the soil from Culloden 60-acre field is described as being the *best* of the four soils examined and contained the most organic matter, the most Nitrogen and the most water retained in the air-dried condition. Only last Monday I was applied to from the Straits to recommend what kind of manure should be applied on a rubber plantation, so that apparently even there where the soil is superior to that of Ceylon, it was thought desirable to apply some kind of manurial dressing.

We may make sure that many enterprising rubber proprietors, as well as Companies, will begin to see what scientific analyses and cultivation can do for them.—*Cor.*

PROGRESS OF AGRICULTURE IN INDIA.

The Report of the Director-General of Agriculture in India for 1907-1909 is a comprehensive document consisting of 80 pages of printed matter, and touching upon all the phases of so complex a subject. We learn that the Scientific Staff of the Imperial Department of Agriculture has been limited by the Secretary of State to 16 European Officers who, however, are provided with a number of Indian Assistants. The Board of Agriculture as constituted in India is an official body consisting of 38 members. It has been definitely settled that Pusa should be chiefly a higher teaching institution with post graduate studies for those who have passed out of provincial agricultural Colleges and for distinguished science graduates of Indian Universities. The Director-General speaks in high terms of Dr. Butler, the Imperial Mycologist, congratulating him in regard to the practical applications of his work to the ordinary conditions of Indian Agriculture, and remarking that his enquiry into the disease in palm trees has been of such value that it is equivalent to saving the cost of his section to India for many years to come.

The Department has now a cotton expert in Mr G A Gammie, F.L.S., under whose advice much useful work is being carried on: (1) in selection and distribution of seed, (2) introduction of superior indigenous varieties and better methods of cultivation, (3) Hybridisation and (4) the trial of exotic varieties.

TOBACCO.

Under the head of tobacco we read that the experiments in the three Presidencies have yielded some encouraging results particularly those at Rampurs which are thought likely to be of substantial benefit to the ryot. A trial of improved methods of curing local tobacco resulted in the best sample being valued in Bombay at five annas a lb., while country-cured tobacco was 1 to 1½ annas. As regards manuring it has been found that 600 lb. castor cake with cattle manure at the rate of 10 tons per acre gives a substantial profit. The effect of manuring was considerably enhanced by deep cultivation. Burmah is experimenting with American varieties of tobacco, and in Madras Messrs. Spencer & Co. are attempting to produce a suitable wrapper leaf for their cigars.

SUNN HEMP.

All this is most interesting to us seeing that both tobacco and cotton are receiving special attention just at present, particularly the former which is the subject of an extensive and costly experiment. We read of *crotalaria juncea*, or sunn hemp (Sinhalese "Hana") that while the fibre does not compete with jute its market value is higher. Sunn hemp is a suitable rotation crop with paddy for which it greatly improves the soil. At present this crop is only seen in the Jaffna and Chilaw districts and gives no promise of extension. In India the value of the crop both from fibre and green manuring has been fully recognised. We read that "the area under sunn hemp has

nearly doubled during the last 10 years in the Central Provinces," also that "the crop is a well-recognised feature of the agriculture of the United Provinces and the trade in fibre is an organised one." With reference to the merits of green manures it was found that *sesbania aculeata* increased the yield of leaf in tea, and that *coganus indicus* produced a large amount of organic matter and improved the texture of the soil; the condition of the bushes and the growth of new wood. Both these green manure plants are well known locally.

The average out-turn of Cassava tubers on the Manjri Farm was 16,248 lb., and the percentage of starch to the whole tubers varied from 16 to 25. The chemistry of the tubers has been studied and reported on by the Imperial Agricultural Chemist. There is much more of interest in this report which we would commend to the notice of those who are following the laudable attempts being made to improve agricultural methods in the East.

THE JEQUIE MANICOBA RUBBER TREE.

[SPECIAL ARTICLE: BY R. THOMSON.]

This new species of rubber is indigenous to the State of Bahia, Brazil. It is a small tree, attaining a height of some 25 feet, with stems from 18 to 20 inches in circumference. It is a closely-allied species of the Ceara rubber, the native habitat of which is separated from this Maniçoba region by some five or six degrees of latitude. Until a few years ago this rubber was unknown to commerce. It grows under peculiar conditions as a product of the forest. In the region I traversed, there are millions of trees, including saplings. The soil in which the Maniçoba grows is peculiar (I have samples of it in London). It is a porous kind of clay, more porous than sticky, the texture of which is eminently conducive to the well-being of the tree during prolonged periods of drought to which it is exposed. Apart from the peculiar character of the soil, its great depth powerfully contributes to the conversion of the moisture which it freely absorbs during the short rainy seasons. In other words, the absorbent power of this great body of earth, not only relieves the surface of any excess of moisture, but retains the moisture during severe droughts, so that the soil is never water-logged, and never excessively dry. This soil, therefore, occupied with the aridity of the climate, is the secret of the existence and diffusion of this rubber tree.

A few years ago I was deputed by Messrs. Elder, Dempster and Co., to investigate the resources of the Pineapple region of Florida. I mention this by way of pointing out the disparity between that soil and the Maniçoba soil. I quote from my published report:—"If the soils of Florida were anything like the soils of Jamaica, it is safe to say that Pineapples would not be cultivated there at all. The soil in which they are planted consists of from 96 to 98 per cent of silica. The growers furnish all the food by fertilizers, which bring forth luxuriant crops . . . On examining a large Pine-apple field that had been some months before uprooted in order to prepare the land for re-planting, I saw many hundreds of rejected suckers that had been cast away over the land actually bearing fruit! In other words, these suckers yielding fruit had no connection with the soil, other than lying on the surface. I was puzzled. But, on reflection, I arrived at the conclusion, that this phenomenal productiveness was due to the great depth of the bed of sand, probably 50 feet, which issued moisture from its huge mass on the principle of capillary attraction."

The supreme importance of soil is further exemplified by the following extract from the *India-rubber World*:—

"After having travelled through all the desirable rubber regions in Central America and Northern South America, I am satisfied that suitable tropical forests which can be had now at a low price—often for a few cents an acre—present an opportunity for the profitable employment of capital such as has seldom been offered in the world's history, but the serious point is to secure the proper land. Those who acquire it will have more than they expect, and natural rubber lands are not to be had by simply making a chance location. Though the trees will grow almost anywhere, it is only the most favoured spots that will yield those spontaneous returns that are so very profitable. It is fair to state that if people go to taking up tropical forests promiscuously, ten will be disappointed to every one who secures a prize."

In the remote district in which this tree grows, the vegetation may be described as a scrub forest. The Maniçoba tree throughout certain areas intermingles with the stunted trees and forms a prominent part of the forest at an elevation of 1,000 to 2,000 feet above sea-level. In the forest there are comparatively few species of trees that exceed a medium size. The country is gently undulating, with low intervening hills. The whole region presents the aspects of a semi-desert, consequent on the character of the soil, which is non-productive of luxuriant tropical vegetation.

Throughout this dreary tract of country, embracing many thousands of square miles, miles at a time are destitute of inhabitants. Running streams of water, so impressive and emblematic of fertile regions, are few and far between throughout the district. At distances, usually many miles asunder, the configuration of the land admits of natural reservoirs which, aided by simple devices, supply the wants of man and beast. Thus, the water is collected at the bases of hills and sloping lands where cavities are formed. Wild animals, including insects, are also rarely encountered. In this connection it is worthy of note that cultivated Maniçoba trees appeared to be practically immune from insect depredations. Ants sometimes overhaul the young leafage, and a young tree is sometimes snapped off at the top by a stray deer.

Another noteworthy feature of this scrub forest may be indicated. The foliage is scant and lacks profuse development in conformity

with the stunted tree vegetation, but it is accompanied by innumerable growths of thorns and spines that contest supremacy with the foliage itself. I have travelled on horseback through many thousands of miles of tropical lands, but never through any part having a tithe of these formidable weapons. The sterility of the region is mainly accountable for this evolution of thorns. Most of the species become thorny, and the thorny species are reproduced superabundantly.

Notwithstanding the severe droughts characteristic of this region (probably the rainfall does not exceed 25 inches a year), droughts lasting six months, and even nine months at a time, many shrubby species of the natural order *Malvaceae* were constantly found in proximity to Manigoba trees. I am intimately acquainted with many species belonging to this order in the tropics, and I was surprised to see numerous species flourish under such conditions of aridity. There can be no doubt that this phenomenon is ascribable to the peculiar structure of the soil. Many species of *Cacti* are interspersed in the shrubby thickets, these being more concentrated at points where the soil is exceptionally arid. It was curious to see several species of palms, moisture loving plants, struggling for existence in these ungenial thickets. Half-a-dozen species of native *Ficus* fine umbrageous trees, flourish adjacent to settlements. (I thought that *Ficus elastica, R.*, among rubber, could be grown to perfection here.) Ferns are non-existent, though I saw after riding 360 miles, a few puny plants in a dark ravine. I visited a coffee plantation at about 3,000 feet altitude. This was the only coffee plantation on an area of many thousands of square miles. The coffee plants yield very small fruit. At this height frequent rains are experienced. And coming from the inland towards the City of Bahia, rains are more frequent, the soil is darker—an ameliorating facter. Tobacco of splendid quality is extensively cultivated here by thousands of small settlers. In juxtaposition *Cassava* (Manioc), the staple food product of Brazil, a congenor of Manigoba, maize and other products, in patches, are commonly cultivated, and crops are obtainable therefrom a few months after the rainy season.

In a report of mine issued by the Agricultural Society of Jamaica, about a year ago, on the Virgin rubber of Columbia (it has been reprinted in many countries), I emphasized the importance of rubber cultivation in comparison with the sparse returns obtainable from wild trees. This is applicable to Para rubber and all other important species of rubber, including Manicoba. In a state of nature, rubber trees struggle for existence amidst a thousand other species of trees. In the near future all rubber must be produced by cultivation like any great agricultural commodity.

During the past year various owners of Manigoba rubber land have been directing attention to the culture of this tree. I visited several plantations ranging from a few acres to a hundred acres. I was anxious to investigate the cultural capabilities of the tree. The owners of these lands are ignorant of the lines on which this culture should be initiated. They take it for granted that sticking the Manigoba seeds or cuttings into cleared ground is all that is necessary without further attention. One important factor is in their favour: I refer to the

WONDERFUL TENACITY OF LIFE AND RECUPERATIVE POWER PERVADING THIS PLANT.

The primitive procedure by which the incipient seedlings and cuttings are left to take care of themselves with a view to establishing plantations, is antagonistic to the development of the trees, for nothing is more important than the proper treatment of young plants in the establishment of great prospective plantations. The result of the preliminary attempts in question was an aggregation of maltreated plants. In this connection it may be noted that about half-a-dozen labourers only, men who know nothing about rubber cultivation, and nobody to instruct them, perform all the work appertaining to tho upkeep of such plantations, comprising some 50,000 plants. Of course, they have but few weeds to contend with, an important consideration, as they are in general suppressed by the peculiar soil and climatic conditions. I therefore could not help coming to the conclusion, that if these improvised plantations were placed under my control, I should re-plant them throughout. Anyhow it is important to be able to add that I found two notable exceptions to this crude style of planting, one of which having a few thousand plants, and the other fifty thousand, on both of which intelligent methods of planting had been adopted. And these two plantatiens, from a practical point of view, were decidedly encouraging. The seeds and huge cuttings or stumps were only four months planted. The seedlings in this time attained a height of from four to five feet, and they were exceedingly healthy and vigorous. The huge cuttings are procured from the forest, that is to say,

SAPLINGS IN THE FOREST ARE CUT DOWN

and stuck into the cleared ground to form roots and permanent plants. These stumps measure from six to eight feet in length, both ends cut off, and in four months the vigorous shoots that spring from the tops are four and five feet in length, thus a continuity of growth from the sapling to the established tree. This plant is an

INVALUABLE ACQUISITION TO RUBBER CULTIVATORS.

It can be cultivated at a minimum cost consequent on its persistent tenacity and vigour as is exemplified in its native soil, and consequent on its other merits to which I have drawn attention. Further, it may be stated that this tree is comparable with particular products cultivated in the tropics and elsewhere, products that flourish in a great measure by the restricted cultivation given. That is to say, when we discover a region pre-eminently adapted for a given culture, there it yields not only the best produce of its kind, but also far more economically.

Again, the humble dimensions of the Maniçoba tree, I am convinced, are a factor in its favour from a cultural point of view, for it attains to a size exactly suited for close planting. In the great *Hevea* (Para rubber) plantations under cultivation iu the East, close planting is systematically resorted to with the object of forcing early crops which are available from young trees of limited size, for numbers collectively far more than compensate for the production of rubber per acre from full grown trees widely planted. As a matter of fact, big trees are stated in the East to be an encumbrance.

The number of trees usually planted in the East run from 100 to 200 per acre, sometimes more. The number of Maniçoba I advocate to be planted is 1,200. I estimate that 1,200 trees per acre (exclusive of certain returns in the fourth year) will yield 600 lb. of rubber in the fifth year; and at least the same quantity annually thereafter for a long period of years. In many rich Manicobazones I computed the number of wild trees at more than 100 per acre, somo 25 per cent being tappable trees, most of the remainder saplings, the forest growth of which is sluggish as compared with cultivation. It may be observed that a wild tree occasionally yields one pound of rubber at a tapping, but the average is far less. One of the advantages, a subsidiary advantage, to accrue from cultivation is that of systematic coutrol of the cropping by a special staff of workers, for the itinerant collectors of wild rubber cannot always be counted on.

I detected in the Maniçoba forests several distinct varieties of this tree, and on enquiry I found that one particular variety was recognised as being richer in latex than others. The varieties are distinguished by colour, size and lobe formation of the foliage which latter are remarkably vigorous in cultivated plants. The uncultivated trees are sparsely furnished with foliage. I have had cousiderable experience with regard to the effects of soil on rubber plants. Apart from the large plantation of *Virgen* rubber which I established in Columbia, I planted experimentally more than quarter of a century ago, both in Jamaica and in Columbia many plants of Ceara, a nearly related species of Maniçoba. Furthermore, I introduced to Jamaica many plants of Para rubber, *Castilloa* and Virgen rubbers. Unfortunately, until recently, no attention has been paid to their propagation in that colony.

The *Hevea* (Para rubber) is indigenous to another part of Brazil. In addition to the boundless tracts of country throughout which it is dispersed, it is a large tree. It furnishes iu a wild state most of the rubber found in commerce. But the natural resources of the forest gradually dwindle. This is the tree for cultural purposes that has claimed the attention of the capable planters of the East with far-reaching consequences. The species flourishes in conditions of soil and climate the couverse of those requisite for the humble Maniçoba tree. Hence, the latter species can never bo cultivated side by side with its great Amazonian rival.

Supplementary to my foregoing account of this species of rubber, I think it is important to cite from, and append hereunto, an interesting article in the Kew Bulletin, No. 2 1908, on this subject, which, *inter alia*, contains much information supplied by Mr O'Sullivan Beare, H.B. M.'s Consul at Bahia, to whom I had a letter of introduction from the Governor of Jamaica :—

In the year 1906, Dr. Ule, a German botanist, who visited Bahia, named the Jequié Maniçoba *Manihot dichotoma.*

"The Jequié Maniçoba is undoubtedly a new and distinct species of *Manihot*, and it must not be confounded with the *Manihot* of Ceareà *Manihot Glaziovii.*

"This discovery is a matter of much importance, not only to this State but also for the rubber trade in general, inasmuch as the rubber obtainable from the Jequié Maniçoba when properly prepared, would seem to be equal in quality to the best product of the Para region.

"The season for extracting the latex from the Jequié Maniçoba extends from August to March. The latex possesses the valuable property of coagulating spontaneously when exposed to tho air, and it requires no acid or artificial coagulant of any kind.

"A planter, established in the Jequié district, recently prepared a considerable quantity of rubber obtained from Manicoba trees growing wild in that neighbourhood, and despatched it to New York. The consignment was classified in the New York market as being equal to the best Para rubber, and it fetched one dollar twenty cents (5*s.*) per lb."

In addition to *Manihot dichotama*, two distinct and nearly related rubber-yielding species of Manicoba were found by Dr Ule, "the one growing on the mountains of the right bank of the Rio San Francisco, and the other confined to the country at some distance from the left bank, occurring especially in the adjoining State of Piauhy." . . . These two species are described under the names of *M. heptaphylla* and *M. piauhyensis.*

My examination of this species of rubber; *Manihot dichotama*, in its native habitat, set forth in my preceding account shows that I am impressed with the remarkable possibilities of tbis rubber yielding plant, thus having arrivod at the conclusion that, under cultivation, it is destined to rank in productiveness, per acre second to none. It therefore seems obvious that some confusion has arisen in the publication of a paragraph in the "Kew Bulletin," wherein this species as regards its rubber-yielding capacities is undoubtedly misrepresented. A comparison is made with this and the two other allied species, namely, *M. hetaphylla* and *M. piauhyensis.* Iu this comparison it is stated that the yield of rubber per tree under cultivation for the two latter actually exceeds the yield for *M. dichotama* five-fold? Thus "the yield of rubber from a single tree of *M. dichotama* in one year can be reckoned at from 100-200 grammes." And, the anuual yield of rubber for single trees of *M. piauhyensis* is from 500-1,000 grammes." Said paragraph is here subjoined:—

"PLANTATIONS.—At present the plantations of *M. dichotama* are rather young and only the oldest are ready for tapping ; but from the two other species, which have been known longer, a satisfactory amount of rubber is now being brought on to the market. In the plantations

which are laid out in a quite primitive manner, the seeds are planted in rows 2 metres apart, making 2,500 trees to the hectare (2·47 acres). Other plants may be grown between the rows during the first year. With regard to tapping, *M. piauhyensis* is ready in the third year, and the other two species may be tapped in their fourth year of growth. The yield of rubber from a single tree of *M. dichotama* in one year can be reckoned at from 100-200 grammes with present methods, and this is equivalent to 200-300 kilogs. per hectare. The annual yield of rubber for single trees of *M. piauhyensis* and *M. heptaphylla* is from 500-1,000 grammes, which corresponds roughly, to about one ton per hectare."—*Indian Forester*, for January and February, Nos. 1 and 2.

BRAZIL-NUTS.

The Brazil-nut tree (*Bertholletia excelsa*) belongs to the monkey-pot section of the myrtle family, and is a native of Brazil, Guiana and Venezuela, forming large forests on the banks of the Rio Negro, Amazon and Orinoco. Travellers describe it as one of the biggest tropical trees, both in height and circumference. The fruits, which are produced on the upper branches, take upwards of a year to ripen, in which state they consist of a perfectly round hard shell about half an inch thick, containing 15 to 25 closely-packed three-sided, rough-shelled seeds (nuts). When ripe the entire fruit falls from the tree. It differs in this respect from the allied Sapucaya nut, whose fruit splits while still on the tree, letting the seeds fall to the ground. The leaves are broad and smooth and about 18 in. long. The erect flower spikes are about 2 ft. long, and bear many cream-white flowers, which open one by one.

The tree is so slow of growth that while the native supply continues abundant, it is not suitable for commercial planting. It has, however, long been thought suitable for introduction into our eastern colonies and Australia, and this is not a matter of great difficulty. Fresh seeds may be obtained in London in early summer, and should be packed for re-export in coconut fibre. On arrival the shells of the seeds should be very carefully removed, and the kernels sown in nursery beds, when they will quickly germinate. Two trees, which were planted in Singapore in 1881, first fruited in 1902, and have since borne nuts annually in increasing quantities. The biggest tree is now 65 ft. high.

The manner of the germination of the seeds in a wild state was long a matter of speculation. It is accomplished as follows :—In each fruit there is a small hole at the point where it was attached to the stalk. Through this, after a considerable time, the shoot of one of the germinating seeds contrives to effect an exit. The other seeds, unable to find an outlet to reach the light, perish, but they are thought to be useful in serving to nourish the solitary plant which grows, and ultimately bursts the shell confining its roots, which then strike into the soil. Experiments showed that even if the seeds are removed from the fruit case they take a long time to germinate, but that when the kernels were removed and sown the young plants appeared through the soil after ten days.

—*The Field*, February 19. K.

PADDY EXPERIMENTS IN INDIA.

The following details of an experiment in paddy cultivation at the Dumraon Agricultural Station—given in the report on the Station for 1908-9—should prove of interest to local cultivators. The paddy grown was a variety known as Bansphul, a medium-grained sort.

Acre plots were manured as follows :—(1) 50 maunds (80 lb. per maund) cow-dung ; (2) 100 maunds cow-dung ; (3) 34 maunds cow-dung and 3¾ maunds castor-cake ; (4) 3 maunds bonemeal and 1 maund saltpetre ; (5) sunn-hemp green manure ; and (6) Dhaincha green manure. One plot (7) was left unmanured.

The seed-bed was sown on June 1st, and transplanting (two seeds to each hole) took place in the 2nd and 3rd week of July, and the crop was harvested in last week of November. The following table gives the results :—

Out-turn Per Acre in Maunds.

	Grain	Straw.
(1)	32	60
(2)	26¼	47
(3)	37½	82½
(4)	27½	56¼
(5)	29	57½
(6)	25	48
(7)	22½	31

Another experiment dealt with varieties. This experiment was begun in 1906, and the results prove that for a fine medium and coarse-grained rice, the varieties known as Srikola, Bansphul and Maharajwa paddies are the best. These yielded per acre, respectively, 22½ maunds grain and 51¼ straw, 16 maunds grain and 27½ straw, 30⅛ maunds grain and 56 straw. The selection of a coarse, medium and fine-grained variety must depend entirely on the market and be decided by the cultivator himself.

Still, another trial dealt with the question of draining the field during the last fortnight. This is the usual practice and is known as *nigar*. The continuance of water on the land is indicated by the term no-*nigar*. The following were the results :—

Out-turn in Maunds (80 lb.)

	Grain.	Straw.
Nigar	18⅛	56⅞
No-*nigar* ...	13	40⅝

Hence the results were very much in favour of *nigar*. In the no-*nigar* plots the plants were sickly and were badly attacked by caterpillars.

The conclusions to be drawn are : (1) that a mixture of 34 maunds cow-dung and 3¾ maunds castor-cake is an economical application, while green-manuring with sunn-hemp (*Crotalaria juncea*) and Dhaincha (*Sestunia aculenta*) is well worth the attention of cultivators ; (2) that the practice of witholding water from the field during the last fortnight of cultivation is to be commended.

To show the value of conserving manure, a trial was made in manuring paddy : (1) with 100 maunds cattle-dung and urine protected from sun and rain ; and (2) with the same quantity of ordinary exposed manure used by the ryot. The results are very striking, for, while the yield in the former case was 26½ maunds grain and 47 straw, in the latter case it was 15¾ maunds grain and 27½ straw.

INTENSIVE RUBBER CULTIVATION.

Mr Norman Thomson, of 2, Princes-garth, Forest Hill, a son of the late Mr Robert Thomson, head of the Jamaica Botanic Gardens, tells of an interesting secret process for the intensive cultivation of rubber :—

" An acre of Para rubber costs some £30, including interest on capital, &c. After a number of years a yield of 300 lb. may be expected, but a crop is unobtainable under five years. A few years ago 100 lb. por acre was considered an excellent yield, but experience seems to justify the planters' optimism in regard to a yield of 300 lb. per acre. One of the pioneers of rubber cultivation, my father revealed to me prior to his death a project for rubber cultivation which, if it meets with any success, is destined to affect the question of rubber cultivation to a considerable extent. I am now arranging to put into execution, on an experimental scale, the system in question, and while the cost per acre, including interest on capital, will not exceed £90, the yield in three years will amount to as much as 1,000 lb. per acre.

"In other words, while the capital outlay per acre will be three times greater than is the case with Para cultivation at the present time, the yield will be more than three times as much, and a saving of several years will be gained before the stage of production approximates."

Mr Norman Thomson adds that the system he has in view embodies conditions of scientific cultivation adopted in the case of other tropical cultures with conspicuous success, and that only an intimate acquaintance with certain tropical cultures has made it possible to construct a theory in regard to rubber cultivation which he holds, may conceivably revolutionise the rubber industry.—*L. & C. Express*, Feb. 18.

"CEYLON."

" RUBBER AND OTHER PRODUCTS "

is the heading of an article in the London *Times Financial and Commercial Supplement* of Friday, February 11. We quote the following extract :—

PROSPECTS FOR RUBBER.

The exports of rubber from both Malay and Ceylon, as well as from Southern India, Sumatra, Java, Borneo, &c., must very soon now increase rapidly. The *minimum* estimates of shipments have usually been from 25,000 to 35,000 tons of raw rubber for the whole of South-Eastern Asia by 1915 ; but this estimate may be increased in view of the recent experience of the large yields of latex obtained from Para trees as they grow older in both Ceylon and the Malay States. One company's plantations show results that would point to a much bigger total five or six years hence for all the Eastern planted area then in bearing. For instance, the yield from the 10 oldest Para trees in a Ceylon plantation—trees quite over 20 years at least—has averaged 18 lb. per tree per anuum during the past four years, and the best tree gave 25 lb., the poorest yielding 13lb. last year. There is, however, no plantation or even 1,000 trees so old as those on a single estate in Ceylon, for there were only 750 acres of rubber planted by 1898, 2,500 acres by 1901, and about 10,000 area about the middle of 1904 Now the *Ceylon Handbook and Directory* for 1909-10 gives a total of 184,000 acres of rubber for the island and about 550,000 acres for all Asia, but the Malay States are reckoned by some local authorities to have at least 240,000 acres planted and many of the plantations there are much older than any in Ceylon, as shown by the fact that their total annual exports are already more than four times that of Ceylon. The immediate question of interest is that of the probable exportation of raw rubber for 1910, 1911 and 1912, respectively, from Southern Asia under the impetus of the keen demand and high prices now prevailing.

I VENTURE ON AN ESTIMATE,

chiefly based on Malayan and Ceylon experience but allowing for what may come from India, Java and other parts of the Eastern Archipelago, including gatherings from indigenous rubber-yielding trees, as follows:—For 1910, about 8,000 to 9,000 tons (worth over £5 500,000,; for 1911, a total of about 13,500 tons; and for 1912, about 19,000 tons. It is quite certain that Eastern planters can face a considerable fall in present prices with equanimity as they can put their product at a low rate on the London market. The only difficulty will be found in properties bought dearly or over-capitalised. Later on the real competition will be between Eastern and Brazil and African rubbers, that is when the total production overtakes the demand though of this there is no present appearance. Those who may be still going on planting rubber should consider carefully how the situation may be by 1915-16, in respect of consumption *versus* production. It is remarkable how freely Ceylon-trained planters have gone to the Malay States, India, Burma and all the East, as far as New Guinea (where Para rubber is doing well), and to the Solomon and South Sea Islands as well as to East Africa and the West Indies. [Various products and Area under Cultivation are then dealt with.—A. M. & J. F.]

RUBBER AND CLEAN WEEDING.

The following extract from a recent Circular issued by the Director of Agriculture, Nyasaland, is reprinted from the *Agricultural News*:—

" It has been proved that the flow of latex from a rubber tree is affected by endosmotic pressure, which practically means the amount of water in the plant roots. It is the practice to tap rubber in the early morning and evening, and to discontinue during the heat of midday and early afternoon. During the heat of the day much water is evaporated by the leaves, and latex flows slowly, but in the early morning and evening water wishes to enter by the root quicker than it is evaporated, with the result that there is an internal pressure which helps the flow of latex; therefore it is practical to assume that there is an intimate connexion between the presence of water in the surface soil surrounding the roots, and the flow of latex from the rubber tree. For half the year in Nyasaland there is no rain, and daily the sun is strong enough to evaporate water from the plants and from the soil. The question arises, where does this water come from? The answer is, from the lower layers or subsoil, by the rising to the surface in the form of water vapour and water liquid (capillarity). In the surface soil of a clean-weeded estate the water during the day is principally in the form of water vapour, the water being vaporized to a considerable depth by the direct, overhead rays

of the tropical sun. In the surface soil of an estate growing a green manure crop, there is a large proportion of the water in the liquid form, as the covering of vegetation reduces the temperature of the surface soil, and prevents the direct penetration of the sun's rays. Therefore, when rubber is growing surrounded with vegetation, its roots have actual access to liquid water through the greater part of the day. If we examine the same soils during the dry season after the green manure crop is dead, we still find more moisture in the latter, as the dead remains of the green manure crop absorb and retain water more firmly than ordinary soil, but deliver it freely to the rubber roots, although not as freely as to the atmosphere."

During my recent tour in S. Travancore, I conducted an experiment upon one estate which I visited which exactly bears out the above statement. Two samples of soil were taken, one from under a very poor covering of Passiflora, and one from a patch which had been kept clean weeded and exposed day by day to the baking sun. Equal weights of these samples were dried in an oven for five or six hours and then re-weighed. The result showed that the soil under the Passiflora, though this was of poor growth and gave a minimum of shade, contained 11 per cent. more moisture than that on the clean weeded area, which represents a large amount of water. This experiment is a strong argument in favour of keeping the ground covered with a growing cover crop even during the dry season. A three or four foot circle round each tree should be clean weeded and kept covered by a mulch, and the rest of the land should be covered by a growing crop of Passiflora, or better still of a leguminous weed like *Cassia mimosoides.* The disadvantage of having the whole soil covered with a dead mulch is the great danger that is run of fire, especially when the estate is surrounded, as it was in this particular instance, by jungle in which fires are constantly occurring. A system of clean weeding which leaves the soil exposed during the dry season to the wind and sun, results in an enormous loss of moisture, far more than is taken out of the soil by a growing cover crop, and this loss, as the above extract shows, it is important to check.

Apart from this, when the heavy rains of the monsoon period come, the loss of surface soil from wash is very large, and each year this valuable surface tilth is carried away, and the soil is constantly being denuded and impoverished. A cover crop breaks the force of the rain and prevents this wash. Paddy fields in boundary with some clean weeded estates which receive the wash from the latter, are giving increased crops due to the fine surface soil from the estates which is deposited upon them; a fact which speaks for itself.

RUDOLPH D. ANSTEAD, Planting Expert.
—*Planters' Chronicle*, S. India, March 19.

THE CINCHONA AND RUBBER BOOMS COMPARED.

The question may reasonably be asked, says the *Chemist and Druggist* March 12th, is cultivation to do for the rubber forests what it has done for the South American cinchona groves? With cinchona we have, after about three decades of cultivation in the East, the drug marketed in more reliable quality at a price which is reckoned in pence, where thirty years ago shillings were paid. Then the demand for cinchona was in excess of the supply, just as rubber is now, and, although the total money in it was small compared with rubber, the necessity for cinchona was as great. Cultivation of rubber trees in the East and elsewhere than South America is a modern factor in rubber supply. At present most that the world uses comes from natural forests, and it is not a quarter of a century since there was grave doubt about the possibility of cultivating rubber yielding trees in the East. Thus, writing, in the *Chemist and Druggist* of July 23rd, 1887, a Ceylon correspondent said:

"It is rather remarkable that, considering what a great success cinchona production has been in Ceylon, greater trouble has not been taken with the india rubber tree. The climate suits the plant, and its juice seems to be as free and a plentiful as in Para; but none of the planters seem to be able to do anything with it. Some years ago thousands of trees were planted, and are still standing, but rubber does not yet figure in the exports. I am told that the soil and climate are too good, and the foliage gets so heavy as to break down the tree long before the age at which it produces good rubber. But surely if that is really the evil it might be met by careful lopping and proper supports."

SYNTHETIC CAMPHOR.

—is not yet added to the successful achievements of modern chemistry, as a companion to artificial dyes, synthetic perfumes, and a few other products which have made millions for discoverers and manufacturers. The failure of the French Camphor Company has parallels in other countries, and is directly attributed to the Japanese Government reducing the price of natural camphor below the price at which synthetic camphor can be produced; but there is another factor not generally recognised—namely, that synthetic camphor, when used in wardrobes, gives garments a musty odour, which is due, I understand, to traces of impurities that cannot be profitably eliminated. Chemists say that the two kinds of camphor are identical except as regards their optical properties, but the musty residue of the synthetic stuff is as clear a distinction.—*Chemist and Druggist*, March 12.

TRINIDAD CACAO AND EXPORTS.

The adverse effect of black rot (*Phytophthora omnivora*) on the yield of cacao is illustrated by the following experiment, which is recorded by Mr J H Hart. In this, diseased and healthy beans were fermented and cured in a similar manner and at the same time. It was found that, while 432 beans from healthy pods weighed 1 lb, with diseased pods 565 beans were required to make up the same weight. This corresponds to a loss of about 25 per cent, with, of course, a lower quality of product.—*West Indian Agricultural News*, Dec. 11.

THE ENEMY OF THRIFT IN CEYLON.

CO OPERATIVE BANKS REQUIRED TO SUPPLANT THE CHETTY.

A letter signed "Outspoken" which appeared in our daily *"Ceylon Observer"* of March 28th, throws some light on the manner in which the industrious cultivator in Ceylon is deprived of the full benefit of his arduous labours; how he is compelled by circumstances to borrow money to bring his crop to market and how the puissant Chetty, being the only source of supply available, battens on the villager's helplessness by extorting exorbitant rates of interest. What is true of the tobacco industry in Jaffna is no doubt equally the case in other native agricultural industries in other parts of the country. The wide scope which exists for the Agricultural Society, with the assistance of Government, to do something to remedy this by spreading the system of Agricultural Credit Banks and popularising them among the masses, becomes more apparent the more closely the methods in vogue and the exactions of the Chetty are studied. Not a few may be inclined to question the wisdom of supporting or encouraging any system which makes it easy for a man to conduct business with borrowed money. This idea, however, is based on misconception. Credit is the foundation of modern business methods. It appears to have been in existence in Ceylon among the cultivators for generations; and what is desirable is not that the cultivator should be asked to give up borrowing, but that a source of borrowing should be put within his reach which would enable him to obtain advances of money for useful purposes at a reasonable rate of interest and permit him at the close of the harvest of his crops to enjoy a more substantial share of the profits than the exorbitant charges of the Chetty now allow. An Agricultural Credit Bank—which is a Co-operative Society—would do this. Such a bank is no philanthropic institution. It is conducted on strictly business principles. It is co-operative. Its keynote is "self-help" while in its operations it is local, members living within a small area and being well-known to one another. There are one or two such banks or societies already started in Ceylon and the experience of the promoters of these would be most valuable in the formation of any scheme for the extension of the system in the island. Credit Banks do not distribute dividends, and, the expenses of management being very small, money can be lent at a low rate of interest. This is the main object for which such Banks are formed. Money is only lent for purposes of production or economy and a borrower must state the purpose for which he requires it and must undertake to apply it to that particular purpose. A credit Bank can only lend to its own members; and its success will largely depend upon its admitting as members only those whose industry and honesty are beyond question. To every properly equipped bank there should be attached a department for receiving on deposit the savings of its members. This is an important point. Little or nothing is done in Ceylon to foster the habit of investment among the rural population—by which we simply mean the habit of regularly putting by a small portion of the family income, not in a hole iu the wall, but in the hands of some person or institution who can be trusted to keep it safe and to pay interest for its use. In the cities and towns there are the Post Office Savings Banks and in Colombo the Ceylon Savings Bank. The skilled workman who can as a rule earn wages considerably in excess of his needs has no excuse for not saving a little. Alas, however, for the absence of the investment habit, our workmen are too often prone to indulge in holidays to the extent of their "surplus balances" and work only a sufficient number of days to give them the money they absolutely require for their immediate needs. The cultivator or small landholder away in the interior has very few resources; and when he makes a little extra profit, if he does not put it into the improvement of his land, he is inclined to spend it thriftlessly and improvidently. The village co-operative credit society, with its elastic system of deposits and loans, would enable even the smallest cultivator to build up by degrees a substantial reserve fund invested outside his holding, and therefore protected from chances incidental to the agricultural industry. One does not have to look far into the whole question to realise that very little is being done in this country to encourage thrift among the masses. The grip of the money lender appears to lie heavy on the shoulder of every workmen in Colombo, and his trail is over the paddy patch of the humblest cultivator. The extension of co-operative credit banks in the rural, as well as in the urban districts would put a stop to much of the heartless fleecing now carried on by chetties, and would in time spread those habits of thrift and industry among the masses which would do so much to add to their own comfort and well-being and render them more prosperous in their business and independent in their private life.

NEW PROCESS FOR DRYING FRUIT.

The Acting British Consul-General at Chicago reports that a new method of drying fruit and vegetables, adopted at Wankesha, near Wisconsin, has proved a decided success. The plant is set up in a fruit and vegetable producing district, and contracts are made with farmers to plant a certain number of acres. The fruit and vegetables are taken as they are picked, and are dried by a new process, the length of time required for the operation varying from six to thirty hours. A plant to put out from 250,000 to 350,000 pounds of dried fruit and vegetables a year would cost about £5,000 to erect, and rather more than this amount would be required annually for working expenses. The United States military authorities have tested samples of all the fruit and vegetables dried, and have reported on them. In the case of spinach, soup, greens, carrots, rhubarb, &c., the cooked dry food cannot, it is said, be told from the fresh; in the case of others, such as potatoes, the flavour is different, but palatable. Parts of the process are patented, but the most important particulars of the method are not made public.—*Society of Arts Journal*, March 11.

CLEAN WEEDING FOR RUBBER.

An experienced practical planter, with a strong bent towards botanical sciences, asked by us the other day if he believed in permitting the growth of weeds on rubber estates, replied emphatically: "Theoretically it is all right: in practice it is hopelessly wrong," and he went on to relate how he had allowed an area of rubber so to be covered with weeds with most disastrous results. The growth of the trees was retarded; and in the covering formed by the weeds, all things that creep or fly, injurious to the rubber tree, found refuge—bandicoots and porcupine being particularly destructive. We think, whatever scientists may say, the best practical planting experience in Ceylon will be found to support clean weeding as against unweeded estates. On the former the growth of the rubber is unquestionably more rapid, while the danger of damage from pests is reduced to a minimum. Weeding is expensive and this is a drawback to the system; but weeding is not going to be a permanent charge, for, when the rubber grows up and covers the land like a forest, the necessity for weeding on the same scale as is required on a young plantation will disappear. In any case the planter at present feels the money spent on weeding brings a handsome return in very much quicker growth and practical immunity from pests; and the returns from rubber will stand it. There is, of course, a great deal to be said in favour of the growing of cover plants instead of clean weeding, and on sloping land especially, an immense amount of top soil containing a large proportion of humus can be saved by this method. Able and experienced Ceylon planters, however, have come to the conclusion that growing such plants adds to the difficulty of supervision on large areas of rubber. In short the conclusion arrived at appears to be that "the game is not worth the candle," and that clean weeding, well done, is the cheapest and most profitable system in the long run. One rarely comes across a Ceylon rubber estate now, which is not clean weeded. A glimpse at the other side of the shield is given by Mr. H.N. Ridley, Director of the Botanic Gardens, Straits Settlements, in the March issue of the *Agricultural Bulletin of the Straits and F. M. S.* in an article on the Tillage of Soil in the course of which he deals with "Denudation." The rainfall in the Malay Peninsula, he says, is very heavy, and in exposed situations and on slopes the loss of soil in a heavy shower is very large. Where the rain runs over these slopes, in a very few minutes it is seen to be quite opaque from the soil washed off. With this soil goes all exposed humus, decayed leaves and sticks. . . . . When grass grows over the stiff clay soil it prevents denudation to a very much larger extent, and in a few years produces a layer of humus which fact itself shows that denudation has been stopped; the roots also break up the stiff clay soil for some depth, and render it possible for other roots to penetrate." Mr. Ridley quotes the following observations made in the Botanic Garden to support his theory:—

"In examining, the rubber plantations in the Botanic Garden a very strong contrast is to be noticed where a path through the trees has been opened and kept free of grass. The ground is covered with roots of Para rubber trees, the tops of which are an inch and-a-half or more above the soil. Examining the ground on the other side of the tree, which is not weeded, I find the corresponding roots as much or more below ground, so that the opened path (not opened many years, and well shaded so that the rainfall is broken up by the foliage above and does not fall so heavily on the ground) has lost four or five inches of soil since it was opened. In the case of another lot of trees seen in Perak, where the ground was bare, sloping and of stiff clay, roots as thick as the wrist were completely exposed and dead, the ends being gone. These roots must have been originally some distance under ground. The roots of the Para rubber lie usually very high, but this doubtless depends to a large extent on the depth of the water, in the soil. In the damper parts of the Botanic Gardens the rootlets of the Para rubber come quite to the surface wherever there are any decayed leaves and even sometimes rise up between scraps of detached bark on the trunk of the tree itself. Dead wood, old stumps are quickly invested and permeated by them. This, I think, shows that Para rubber demands good humus and is ready to utilise all it can find. The fallen leaves are kept on the ground in all estates to decay, but a very large portion of the resulting humus must be swept away by the heavy storms of rain as there is nothing to prevent this in a clean weeded estate especially on the slopes."

Dealing with the question of "the Action of Sun Heat," Mr. Ridley says:—

"The action of the heat of the sun in cleared ground is another factor which has to be considered. It is not at all uncommon to see the ground beneath the rubber trees deeply cracked after hot weather. As Para Rubber roots high, and frequently the rootlets come very near the surface, under such circumstances a considerable number of the small growing roots must be broken across by the cracking of the soil, and further the great heat on the exposed earth will probably injure the roots lying near the surface even if the soil is not cracked. Injuries caused by excessive heat, however, should only affect young trees, where the ground is insufficiently shaded by the trees themselves. A grass covering of the soil prevents cracking and also the excessive heating of the soil. More experiments are required to decide how far sun heat on the bare soil is injurious to the young roots. It has been the custom in the Botanic Gardens to clear the soil round the palms of herbaceous plants, grass, and other weeds, leaving a circle of bare soil round each plant. This was done for convenience in manuring. On one occasion, however, the ground round the palms was turfed up to the stem with the result that they made quite a surprising growth, now the greater part of the roots of the palms were really under the grass, and the only ones affected were those close to the base of the trees. The only conceivable cause of improvement from turfing up the circles is that these roots were protected from sun heat, and consequent excessive drying. Palms do not give much shade with their leaves, and the roots close to the stem are practically exposed to the full sun all day."

WEEDY V. CLEAN RUBBER ESTATES.

CLEARING LAND TO AVOID DENUDATION, EROSION AND WASH.

In continuation of our foregoing remarks we cannot help thinking that very grave errors have been made in the past—in fact, ever since the early days of planting coffee which was confined, we believe, to between 1,000 and 6,000 ft. An old planter who is still with us and who has, he says, given the matter an immense amount of consideration, has now no hesitation in denouncing: first, the very wasteful process of clearing our land by felling and burning it off, which he says was done simply to make a good clean surface and to facilitate subsequent work. Taking the felling first, he is convinced that the proper course would have been, in order: to fell, pile and burn the underwood—very small in the case of heavy forest owing to the dense shade—; then road and drain, line, hole and fill in—the felling contractor coming behind and felling the big trees lopping, piling and burning one by one—and so get all ready for the rains. In the case of Rubber he thinks the following should most certainly be the process: first, cutting good big V-shaped holes, taking out the top soil for the first foot in depth, placing it to one side and discarding the bottom soil taken out, filling in the hole with the fine vegetable mould just taken out, as also that on the surface near the hole. This should give the rubber plants the *very best possible start.*

The present-day style of lining cannot, he thinks, be improved on; but he points out that in planting rubber on anything like steep land every peg should have *two holes* so placed that a line drawn from hole to hole will be 10 ft. apart and lying at right angles to the *hill and (or) wash.* It is best not to drain as usual, but cut dead level silt-traps 14 ft. by 18 in. by 18 in., sufficiently far away from and above the 2 plants, to allow for future root and stem growth. Of course, the silt-traps will cost something extra; but it is only 14 feet of drain really for every peg, or 1512 feet of drain per acre. There would be no other draining. Surely rubber is worth it? The soil from the trap should be placed at the upper side of the two plants and below this trap, and so with the trap form a permanent *terrace or barrier* against all future wash. Surely, it is urged, our valuable rubber trees are worth such treatment, which will make safe and profitable the planting of our steepest forests. Should the planter prefer planting 20 by 20, or 15 by 15, then in either case each plant should have its own silt-trap. But, for all steep land, planting 10 by 15 or 10 by 20 is recommended, the 10 ft. being *between the rows*, so as to admit of the one level silt-trap, in every case, protecting two trees. Our friend would, therefore, recommend on easy or flat land lining 20 by 20; but on steep land, at every peg placing two plants 10 ft. apart in a line against the wash. This would give about 216 trees per acre; that is, if the ground is not very rocky. Beyond growing a clump of mana grass, in the centre of each square, sufficient for mulching the ground round the young plants, there being eight plants to a square, he would strongly recommend *clean weeding from the first.* The mulching should be done immediately before the dry season sets in, so as to develop and preserve the feeding roots near the surface. The mana plants should also be planted so as to form an additional barrier against the wash, our great enemy; and no matter how the feature or slope of the land changes, stick to the same style of lining. Only in every case when land is steep, stick in the two plants for each peg. His idea is that if anything is to be grown the first few years it should be something with which the young plants may be protected from the sun during our long periods of drought, practically our tropical wintering season—the intense heat doing the work of the cold season in Europe. Had good old King Coffee been planted in hedges, such as suggested, with the silt-catching traps above each set, Ceylon would probably never have seen the terrible leaf disease, and we might still be exporting our 1,000,000 cwt. per annum. The most common thing in olden days, on looking at the soil being carried down the hill in a heavy N.E. plump, was to hear the planter exclaim: "See! Off goes our best top soil—down the Mahaweliganga—to Trincomalee."

RAMIE WOOL.

The last issue of *Capital* contains a communicated article, which gives a description of a new development in connection with ramie that promises, if successful, to make the fibre one of the most useful employed for textile purposes. The trouble hitherto in connection with this fibre has been that the processes of decortication and degumming have been so unsatisfactory that the fibre has lost much of its value for industrial purposes. It is now stated that a Mr. R G Orr, of London, has invented processes and machinery by which the ramie is made to produce something entirely different from the material hitherto obtained by mechanical or chemical processes. Mr. Orr calls the product 'processed ramie,' and he claims that it can be shipped by the producer to the manufacturer, who, by passing it through a carding machine, can manufacture a material called 'ramie wool' which can be put to all the purposes to which ordinary wool can be put, from the manufacture of 'shoddy' to 'woollen' goods that are said to compare most favourably with the natural article. Mr. Orr estimates the cost of treatment of a ton of dried ramie at R7-8, and that the treatment will extract more fibre than any other. If this is the case, there is a bright future for ramie in the East where the difficulties already referred to have stood in the way of its planting being taken up more extensively by those interested in developing industrial resources.

TEA IN NATAL.

The Imperial Trade Correspondent at Durban (Mr. A D C Agnew) reports that the area covered by tea plantations in Natal is stated to be 6,000 acres, two-thirds of which are in full bearing. Last year's crop was 500 tons larger than that picked in the preceding season, but it was insufficient to meet the demand. The coming crop promises well.—*Board of Trade Journal*, March 10.

BACTERIAL BLIGHT IN COTTON.

(*Bacterium malvacearum.*)

NOTES BY J. STEWART J. McCALL,
Director of Agriculture, Nyasaland.

This bacterial disease of cotton is by far the worst enemy of Egyptian cotton cultivators in Nyasaland, and in the past season has reduced the output of several estates by at least 60 per cent. The disease was first noticed by the writer in April, 1909, infecting ratoon cotton on the late Oceana Consolidated Co.'s Estate, Kaombi, Chiromo, and judging from correspondence on the subject the ultimate closing up of the said company's interest in Nyasaland may be largely attributed to the ravages of this disease. Later in the season the writer observed it in several localities including Port Herald, Chiromo, Maperera, M'pimbi and Liwonde.

Bacterium malvacearum is prevalent in the south-eastern States of America, and was largely responsible for the repeated failure of all attempts to cultivate Egyptian cotton in this section of the cotton belt.

Egyptian and Sea Island cottons are peculiarly subject to it, but varieties of American Upland cotton have developed such a high degree of resistance that one might presume *Bacterium malvacearum* is an American disease: it is comparatively rare in Egypt.

SYMPTOMS OF THE DISEASE.—The bacterial disease is found on different parts of the plant producing various symptoms and receiving various names, such as black arm, boll spot, black rust, angular leaf spot, &c., depending on the point of attack. The disease first appears on the leaves where it produces the characteristic angular leaf spot, first watery green and ultimately reddish black in colour. The distribution of the diseased angle spots on the leaves is irregular, but most numerous along the veins and more especially towards the base close to the petiole by which it enters the branches. It rapidly causes the leaves to shed and the bacteria may also gain entrance to the branches through the leaf scar, ultimately producing irregular dark lesions on branches and giving rise to the name black arm. Once the disease has entered the crop it spreads with wonderful rapidity throughout the field; in a short time the young branches carrying the flowers and bolls wither and die, the crop turning black and leafless as if attacked by frost. In Nyasaland the bacteria seldom produce boll rot, but sometimes a plant mildy attacked by angular leaf spot is also attacked by anthracnose fungus, the latter gaining entrance through the bacterial spots or lesions and rapidly causing boll rot. Fortunately for Nyasaland the two diseases have practically no facultative relationship as anthracnose on the Shire river is rare in comparison with parts of the American cotton belt. It is a fact worth recording that boll rot caused by anthracnose is more frequently met with in the highlands, and thus bears out the experience of American investigators who consider that the severity of attack is largely in relationship to the rainfall, always being worst in districts with a heavy rainfall. Specimens of diseased cotton from Nyasaland examined by Prof. Orton of the Bureau of Plant Industry, Washington, U. S. A., were found to contain a Fusarium in connection with the bacterium, but those fungi are generally considered saprophytic and therefore in no way responsible for the disease, but simply living on the diseased tissues of the plant.

LOCAL OBSERVATIONS.—At the commencement of Egyptian cotton cultivation on the Shire river it was the general practice to sow cotton at the advent of the rains in November or December.

This cotton always looked well until March or April when it went off suddenly in patches; some gardens being complete failures after giving promise of large crops. This going off was generally attributed to cold or wet, and no doubt they were predisposing causes as it was generally after rain that the crop began to show symptoms of disease. On making an extensive survey of the entire Egyptian crop in the districts already referred to, the writer found the severity of the disease to be subject to the following conditions:—

I. Situation of cotton garden; II. Time of sowing; III. Variety of cotton grown.

I. SITUATION OF COTTON GARDEN.—It was noticed that cotton gardens at or below the level of high river mark were most severely attacked. Everyone who has cultivated cotton knows that a cotton plant is very sensitive to stagnant water, and can withstand drought far better than excess of moisture. Many sections of the land bordering the Shire river are unsuitable for Egyptian cotton cultivation on account of adverse soil conditions such as unsuitable texture, lack of aëration, acidity, etc., and therefore the writer does not recommend planting Egyptian cotton except in free alluvial soils with good natural drainage. The severity of attack is controlled to a great extent by the health of the plant at the season when the bacteria is sporing; this explains why weak cotton growing in wet low lying hollows is first attacked and why the disease always seems to spread from such centres.

II.—TIME OF PLANTING.—The natural time of sowing in countries with distinct dry and wet seasons is the commencement of the rains, but this is not always practicable and Egyptian cotton on the Shire river is a case in point.

At the commencement of cotton cultivation in Nyasaland planters naturally sowed in November and December, but with discouraging results as a large percentage of the cotton died off with this disease. After experimenting it was found that January and February sown cotton although not producing such large plants, gave a better return, as it was seldom severely attacked by disease although growing in the same gardens. The disease in both cases always appeared in April and May indicating those two months as the sporing season for the bacteria on the Shire river, unfortunately the very time when the plants may be checked in growth as it is the beginning of the dry season. When two crops of the same kind, growing on the same soil present marked difference of resistance to the same disease, we can only attribute the greater degree of resistance of the younger plants to their more robust state at the time of attack. It is undoubtedly the case that a plant which has produced flowers and bolls profusely is weaker in its vegetative parts than a plant

which has still this energy to expend; this is an important factor in the control of bacterial disease as inoculation takes place by the leaf. The leaves of the earlier sown cotton are much less active in April and May than the leaves of the younger plants sown in January and February, hence they are unable to resist so successfully the attack of the disease.

III. Variety of Cotton.—As already mentioned Egyptian and Sea Island cottons are peculiarly subject to this disease and it might be further noted that Brasilian and Caravonica cotton is also attacked more severely than Upland varieties. The action of the disease on the different varieties of Egyptian cotton varies:—Jannovitch and Abassi once attacked seldom if ever recover; on the other hand Mit-afiffi will turn equally black in April or May, but when it receives an inch of rain will send out auxillary branches and bear a small crop of cotton. The flowers and bolls of this secondary growth are small with the result that the fibre is short, irregular and weak; it is also difficult to sell being too poor in quality to be included as Egyptian proper and of the wrong colour to mix with American Upland. Nyasaland Upland cotton and Hybrid American-Egyptian show resistance in a marked degree; on one estate in the past season practically all Egyptian cotton was killed out by the disease, and standing surrounded by dead and diseased cotton were two patches of the above cottons practically without disease and yielding a fair crop.

Prevention.—Once the crop is infected, little can be done; but much can be done for following crops by respecting the plant's requirements and favouring healthy growth. The writer feels thoroughly convinced that a large portion of the lowlying land adjoining the river is quite unsuitable for Egyptian cotton although suitable for Nyasaland upland, and recommends prospective planters to carefully consider the situation and texture of the soil before opening up land for an Egyptian cotton plantation. All cotton should be up-rooted and burnt immediately after picking the crop as the old sticks may carry the disease to the next season's crop. The practice of ratooning cotton should be avoided and especially on River plantations. Care should be taken to avoid introducing disease to new plantations by using seed from a plantation already infected. If such seed must be used, it should be treated by soaking for 1 hour in a solution of corrosive sublimate in the proportion of 1 to 1,000 (*i.e.* one pound to 100 gallons of water) or in a solution of 40 per cent Formalin, 1 pint to 50 gallons of water.—*Nyasaland Government Gazette*, Feb. 28.

THE CEYLON HANDBOOK AND DIRECTORY.

The publishers of this standard Directory have had an unprecedented demand for the 1909-10 edition and are now left without a single copy though orders continue to reach them almost daily. The new edition is already in course of preparation and will contain much new information with the old features carefully revised and brought up-to-date, particularly the Planting Review and the list of Planting Companies. In view of the early publication advertisers and subscribers should send in their orders at once to A. M. & J. Ferguson, *Ceylon Observer* and *Tropical Agriculturist Office*, Colombo, Ceylon.

CEYLON COCONUT OIL IN AMERICA.

Annual Report.

With the exception of the period between March and May the market displayed unusual strength throughout the year. This was not in any way due to the demand for soap-making purposes, as has been the case heretofore, but was mainly the result of an extraordinarily heavy demand for edible coconut oil from the margarine manufacturers of both the United States and the Continent. Coconut oil quotations during the last half-year closely followed those of lard.—The year opened with the market firm, which was due mostly to the fact that the bears were covering rather than to any large consuming demand. After these interests had accomplished their purpose the market sagged somewhat, and in February and March sales passed at 6½c., which was the lowest price recorded during the year. Soap manufacturers had been quite active buyers during this period.—Toward the beginning of summer, when the great scarcity of beef and hog fats both at home and abroad became evident, it was seen that the demand for coconut oil for edible purposes would be far in excess of that for soap making, and prices began to stiffen, reaching 7⅛c. in May, 7¼c. in June and 8c. in July. A temporary reaction took place in August, however, and sales passed on the spot at 7½c., and in Oct. at 7⅜c. However, in November the demand for coconut oil from the margarine manufacturers of the continent became again very heavy and spot prices responded accordingly, sales having passed at a minimum quotation of 8 1 8c, ranging up to 8½c, with stocks very light and shipment positions quoting close to the spot quotations. In December the lowest quotation was 9c, sales having passed as high as 9¼c. The shipments of copra from the Far East for eleven months show a falling off of 17,000 tons, which had, in its way, a certain effect upon the market, but the strong and unusual demand for edible oil is mainly held responsible for the strong position of the market throughout the year. The soap interests, realising that coconut oil selling at £10 per ton more than it did at the beginning of the year would hardly be available in a large way for their use, turned to other ingredients, which also advanced in most instances to the highest prices in recent years. The subjoined table gives the high and low prices for each month from January 1, 1905, to Dec. 31, 1909, on Ceylon coconut oil, the figures being based ou the closing quotation of each successive week:

	1909.		1908.		1907.		1906.		1905.	
	H.	L.	H.	L.	H.	L.	H.	L.	H.	L.
Jan.	7	6¾	7	6¼	9½	9¼	6 5-8	6¼	6¾	6 5-8
Feb.	7 1-8	6¾	7	6¾	9¾	9 3-8	6¾	6½	6½	6¼
Mar.	6 5-8	6½	7	6½	10	9¾8	6¾	6 3-8	6 3-8	6¼
April	6 7-8	6 3-8	6¼	6½	9 7-	9¼	7	6½	6 3-8	6 1-8
May	7 1-8	6 5-8	7	6 1-8	9 7-8	9¼	7½	6¾	6½	6 1-8
June	7¼	7 1-8	6½	6 1-8	9 5-8	9	7 1-8	6 7-8	6½	6¼
July	8	7¼	6½	6 1-8	9¼	9	7½	7	6¾	6¼
Aug.	7¾	7½	6½	6 1-8	9¾	8¾	7½	7 3-8	6¾	6¼
Sept.	7¾	7½	6½	6 1-8	8½	7¾	7¾	7½	6½	6 3-8
Oct.	8	7 3-8	7	6½	8¼	8	8¼	8½	6 3-8	6¼
Nov.	8½	8 1-8	7	6½	8¼	7¾	9½	8½	6½	6 3-8
Dec.	9¼	9	7	6	7¼	6¾	9¼	8½	6½	6¼
Year	9¼	6 3-8	7	6	9¾	6¾	9½	6¼	6¾	6 1-8

SHIPMENTS OF COPRA FROM VARIOUS POINTS FOR 1908 AND 1909.

From—	1909. tons.	1908. tons.
Manila, Jan. 1 to Dec. 31	102,500	86,000
Ceylon, Jan. 1 to Dec. 13	34,500	33,000
Straits, Jan. 1 to Dec. 31	73,300	80,000
Java and Dutch East Indies, Jan. 1 to Dec. 31	113,800	146,000
South Sea figures estimated	48,500 tons.	

ARRIVALS OF OIL SEEDS AT MARSEILLES.

	1909. tons.	1908. tons.	1907. tons.
Copra	136,655	163,999	109,744
Palm kernels	3,639	1,675	4,412
Mowrah, Illipe, etc.	8,856	11,146	12,781

IMPORTS OF PALM KERNELS INTO HAMBURG AND HARBURG.

	1909. tons.	1908. tons.	1907. tons.
January-December.	235,616	193,468	118,019
Imports into Liverpool	17,306	20,226	23,450

—*New York Oil Reporter*, Feb. 21.

WESTERN AMERICAN COCONUT OIL TRADE.

Chicago, Jan. 26.—Coconut oil has reached a high point in the West, and has come by some to be regarded as almost a luxury. Soapmakers are forced to bid high for this oil in competition with each other and supplies are reported to be the smallest they have been in recent years. The supply of copra was smaller the past year than it had been the previous year, shipments from the principal points where it is produced being less by about 27,000 tons in 1909 than they were in 1908. Exclusive of Tahiti and the Samoan Islands the shipments were 324,855 tons, against 352,496 tons the previous year, and the outgoing movement from both Tahiti and Samoa was smaller. Reports are to the effect that the crop will not be as heavy this year as it was last year, though it is a little early to make such predictions. There is only a comparatively small supply that is being taken by this country, mills on the Pacific Coast taking it all. The principal mill there reports that it has enough copra to keep it going for some time to come, and with the frequent arrival of cargoes, that there probably will be sufficient for needs, but the indications are that the demand for oil will so increase that prices are likely to advance. European dealers say that the prospects for a lower market for oil are not good, especially as coconut butter cannot be considered now except in connection with a consideration of the lard market. If lard continues high, and there does not seem to be any reason why it should break sharply until after the opening of the packing season next fall, when the country will be in a position to figure on the size of the spring crop of pigs, then coconut butter, as a competitor, must go higher, for it is already selling 4½c. under lard prices in Europe, and is being used very largely as a substitute. The more coconut butter that is used the greater will be the demand for oil, and as the inquiry for the oil for edible purposes is on the inrcease all the time, it is difficult to figure how this oil can remain at present prices unless other facts suddenly drop or the supply of copra is increased beyond all expectations. The price for copra at San Francisco is about $4·95 for the fair merchantable grade, while the sun dried will sell within a range of $5 @ 5·15 per hundredweight. Present prices are the highest, with one exception in the history of the trade and the difference is only a fraction at that. Should Tahiti and Samoa run short, it is likely that the cost of copra laid down in San Francisco will be higher than ever.

European coconut oil has almost complete monopoly of the Chicago market, for the reason that it costs less to get it here from Marseilles than it does from the Pacific coast. For this reason California coconut oil is hardly quotable here, but it has the advantage over the European oil west of the Missouri River. Spot Ceylon oil can be had down in Chicago at about 9½c. per pound but it would cost 9¾c. at the Missouri River, while the California Ceylon can be bought there at $8·55 a hundred. Cochin oil is quoted here at 10c. a pound, and California Cochin at the same price at the Missouri River. From these high prices there does not appear to be any relief in sight and as the soapmakers are increasing their demand all the time, as are the users of the oil for edible purposes, it looks as though the trade will have to find eventually a substitute for this oil, instead of using it as a substitute for other fats and oils. as has been the case heretofore.—*New York Oil Reporter*, Jan. 31.

DISINFECTION OF TEA SEED.

Calcutta, March 31.—The accompanying letter of March 22nd from Dr. Hope is issued for general information.—D K CUNNISON, Assistant Secretary, Indian Tea Association.

Calcutta, March 22.—Formaline is largely used for the purpose of disinfecting seeds. Commercial formaline consists of 40 per cent solution of formaldehyde, which is a powerful disinfectant. Tea seed can conveniently and safely be treated with a 0·25 per cent solution of commercial formaline. This can be prepared by mixing commercial formaline with water, in the proportions of 1 volume formaline to 400 of water. Tea seeds should be placed in such a solution for two hours and afterwards taken out and carefully dried by exposing to the air in a clean cool place. During drying the seeds should be turned over occasionally so as to expose them to the air on all sides.

RUBBER STATISTICS FROM HAWAII.

BY D. C. LINDSAY.

There are in the islands five incorporated companies whose principal business is the growing of rubber. Statistics have been obtained from all of these and also from two individual planters.

No statistics were received from either Kauai or Oahu.

Six reports were received from Maui and one from Hawaii.

The acreage controlled by these companies and individuals is 5,599 acres.

The acreage planted at date is 1,338 acres.

Acreage planted: Hevea, 242; Ceara, 1,092; other varieties, 4; total, 1,338.

Total trees planted: Hevea, 79,940; Ceara, 349,400; other varieties, 800; total, 430,140.

Average of girth: Hevea, 2 years 6, 3 years 8; Ceara, 2 years 8, 3 years 14.

Four places practice clean cultivation. Two of them consider it absolutely necessary. One manager reports that it is entirely too expensive and two have not tried it. The approximate cost of cultivation per acre runs from $14·00 to $24·00 per acre for the first year and lighter for following years. Inter-crops, such as corn, potatoes, beans, oats, and green vegetables are planted on parts of two plantations. While one manager reports that pineapple has been tried, but without success.

One manager reports that inter-crops are profitable only as the returns reduce the cost of cultivation, but would not be profitable otherwise.

Only experimental tapping has been done and the result is yet undetermined. One manager reports very good results.

From reports received there are 11,000 trees that may possibly be tapped commercially during the year 1910. One plantation reports that fertilizers are too expensive to use in quantities enough to be beneficial. Two have not used them. Three places report the use of fertilizers with excellent results and one with fair returns.

For the purpose of getting statistics for next year that might be more reliable and more detailed, I would suggest that a committee of three be appointed; one on Oahu, one on Maui and one on Hawaii, and each one attend to the securing of data on the island on which he resides. These results could then be tabulated as desired. —*Hawaiian Forester & Agriculturist*, Dec., 1909.

RUBBER AND HEMP IN GUATEMALA.

Attention is being drawn in South American quarters to the prospect offered to rubber-planters in Guatemala. Certainly, in respect of humidity, the Atlantic coast of this Republic seems to be well favoured, the average annual rainfall there being 95 ins, as compared, for example, to the 80 ins averaged in Sumatra. The Dutch Colony is taken purposely as a case in point, for some years ago a Dutch rubber-grower imported some Manila hemp-seed for inter-planting with rubber, with apparently very good results; and as the Manils hemp is grown to a great extent in Guatemala it is not unnaturally agreed that, with the good soil, warm climate and high average rainfall, the conditions for succesful rubber-growing are all at hand in the Republic. The Manila hemp (*Musa textilis*) attains a growth 18 months after planting which is sufficient to form a very good shade for the young rubber plants, has very few roots and does not impoverish the soil. Its leaves may be cut and allowed to fertilise the land.—*Financier and Bullionist*, March 17.

EXPERIMENTS IN COTTON G ING IN HONDURAS.

H.M. Consul at Truxillo (Mr A E Melhado) has forwarded a copy of a report made by the Manager of the Honduras National Railway Company of an experiment in the growth of Sea Island cotton made on the experimental farm of the Company near Truxillo. The seed was planted about the middle of August last, at an elevation of about 50 feet above sea level, on a hill-side sloping slightly to the west and well drained. The cotton plants have grown up, healthy and strong, to a height of 10-12 feet. The first bolls matured and opened in December, but, that being in the course of the rainy season, the rain stained the cotton and rendered it unfit for use. Since the heavy rains have lessened, the cotton produce has been of very good quality, and, notwithstanding the loss of the first bolls, the production bids fair, says the manager, to be double that of any he has seen in the United States. The manager is entirely satisfied that cotton can be produced in Honduras at about half the cost of production in the United States, that the production per acre in Honduras will be fully double that in the United States, and that the former country will be entirely free from the boll weevil. It is stated that the cotton plant will grow into a small tree and will continue to produce, so that it will not be necessary to replant the ground each year. There are in Honduras, between the mountains to the south and the sea to the north, 100,000 acres of ground similar to that upon which the experiment is being made, and along the line of the Honduras National Railway the land is well watered and there is a fine climate. The land is at present covered with timber.—*Board of Trade Journal*, March 17.

MR. COCKERILL'S PATENT FOR THE TREATMENT OF LATEX.

Mr Hermann C T Gardner in a communication to the *Financier* writes as follows on the separation of latex :—

An interesting patent was taken out by T Cockerill, of Colombo, in October last, for the separation of rubber from latex by means of the electric current. In this apparatus the latex is made to fall from a trough on to a suitable filter, through which it is passed, and delivered in given quantities on to the surface of a positive electric pole constructed in trough form, with raised edges. This positive electric pole, or anode, is in the form of an endless travelling belt, whose upper surface is suitably connected with a dynamo. This belt is rotated very slowly, and, whilst travelling, separates, by means of the current, the caoutchouc from the latex, becoming covered with the rubber which is removed from it by scrapers fixed at a certain point and sent from them by rollers into a tank of hot water, where it is washed and scrubbed with revolving brushes. From the tank it is transferred to heated rollers, and passed through them, finally being sent to a cutting machine; the exhausted latex passes into a tank

provided for it, to be, if necessary, re-treated. This appears to be an ingenious piece of apparatus which apparently reduces rubber production to a purely mechanical, or physical, process, and, if it carries out satisfactorily all that its inventor claims, should greatly accelrate the output.

The celebrated German chemist, Emil Fischer, has discovered a true solvent for caoutchouc in ethylene dichloride, a volatile non inflammable liquid with a non-explosive vapour. The so-called rubber solvents do not actually dissolve caoutchouc, which is only swelled and diffused through them, aud ethylene dichloride differs from them in that it actually dissolves rubber, or causes it to assume the liquid form just as much as water dissolves sugar, and the sugar passes into the liquid state. This discovery, in all probability, will have an important bearing on the manufacturing industry.—*London & China Express*, March 18.

OUR PALM PRODUCTS FOR THE FIRST QUARTER OF 1910.

STEADY RISE ALL ROUND.

The first quarter of 1910 was a remarkable one in that while nut crops were normal, all products, save desiccated, kept on rising in price steadily instead of falling the same as in other years.

COCONUT OIL.—This is well over last year the figure being 98,514 cwts against 84,621; it is also well over the last four years for this quarter. The price f.o.b. kept on rising until it reached R580 per ton, almost up to the record price (R585) of 1907. This export is remarkable in the face of the great demand for copra.

The United States of America have completely deserted us this year, and any Ceylon oil they got must have been from the United Kingdom. The only way we can account for this is the probable heavy imports from their own Colony, the Philippines, of either oil or copra—able possibly to lay it down *via* San Francisco cheaper than we could from here. Besides, high prices may be driving them back on the cheaper West African palm oil for soap making.

COPRA—both in export and as regards price —has exceeded all past records for the period. The drying of this has been very brisk. Very high prices were paid for best nuts, reaching in some cases nearly R70. The outturn was good it taking about 1,300 nuts to the candy on an average. The export at the end of March (April 4th) reached 134,302 cwts. against 119,873 cwts. to the same date in 1909.

DESICCATED.—This was very dull over the quarter, prices ranging from 18¾ cts. per lb. to 21cts. for ordinary assortment. Some mills had to stop work a short time, while all the rest were going very slow, some turning their attention to copra drying, which seemed to pay them better during February and March. High-priced sugar causes a falling off in manufacture of confectionery, etc., and demand for desiccated nuts from the manufacturers is then poor. Early in the season some millers refused 22½ cts., feeling sure the produce was bound to rise—in sympathy with nuts, oil, and copra; but it was the vory reverse. The year began with very heavy exports, thus making matters worse, and it looked as if heavy shipments had been carried forward from December to January. The swing is the other way now; and our quarter ended (say, on April 4th) with a total export of 4,741,751 lb. against 4,910,386 last year. The outturn was normal, it taking a little under three nuts to the pound.

POONAC.—There is a slight increase in this for the quarter; but, as long as the present heavy shipments of copra go on, we cannot expect to do very much more in the way of shipping poonac.

NUTS IN SHELL.—There is a falling-off in our Coconut Export to date, but of late years there has been little change in our total shipments, our greatest year being 1908 with 21,188,692 nuts; while ten years ago, we were sending away about 150,000,000 nuts.

COIR.—There is very little falling-off in this as compared with last year. Prices have been improving, but, the demand is not what it was a decade ago. It looks as if some cheaper material has been found by the trade.

To give our readers some idea of the importance of our great coconut industry, we find that notwithstanding our having gone through one of our worst droughts, there being little or no rain in some nut districts for fully 18 months, in 1908, our record year,

Oil and Poonac	took	...	268,048,400	nuts
Copra	do	...	215,132,825	do
Desiccated nut	do	...	82,230,690	do
Nuts in shell		...	21,188,692	do
*For Arrack and Toddy and local consumption		...	230,000,000	Estimated
Making a total of			816,600,607	nuts

which, at the low average of 4 cts. each, gives us a total value of R32,664,024·28 against R40,000,000 estimated by Dr. Attygalle a few days ago, a figure which will probably not be far out for the 1910 outturn with its record prices.

* Had the enormous number of trees set apart for this, and which practically yield no nuts, been cultivated as nut-bearers, the estimated total for that year would doubtless have reached 816,600,607 nuts. Surely the great industry is worthy of greater representation in Council than at present obtains, both European and native. The roads—not worthy of the name —are a disgrace to Government in our outlying nut districts.

GUANO FOR RUBBER TREES.

A planter from the Dutch Islands calling recently on Mr H N Ridley, Director of Botanic Gardens, S.S., stated that he had remarkable increase in growth of his Para rubber trees, after using guano, imported from Europe. A small quantity was put round each tree in a shallow trench surrounding the tree and covered in with soil. The cost was three cents a tree. This inexpensive method of manuring might be very useful in bringing on young plants.

SINGLE SEEDLING PLANTING OF PADDY.

The following notes on single-planting of paddy and on the cultivation of Cambodia cotton are by Mr H C Sampson, Deputy Director of Agriculture, Southern Division, Madras, who can arrange to supply the Cambodia cotton seed at cost price to those who wish to try the crop :—

PADDY.

Every one who owns wet lands and transplants his paddy crop is recommended to try the system of planting with single seedlings instead of planting a bunch of seedings together. Planting with single seedlings is the ordinary practice in the Kistna Delta and it would be difficult to find better crops anywhere in the Presidency. Single planting has also been tried aud adopted by many people in Tinnevelly, Tanjore and other districts and now some thousands of acres are planted in this way. All Samba and Pishanam varieties will give better yields if planted with single seedlings and there are other advantages as well :—

1. Less seed is required for sowing.
2. Labour is saved in carrying seedlings from the seed bed to the field and in pulling up and bundling the seedlings in the seed bed.
3. Weeding is easier and water flows more easily in the field. Thus such weeds as Oarai "Nel sakalati" and "Veppam pasi" can be more easily kept in check.
4. As less seed is sown in the seed bed the seedlings are stronger and can stand up better in the field when there is too much water present after transplanting as there often is when heavy rainfalls.
5. If there is a scarcity of water the crop is much better able to withstand drought.
6. Single-planted crops are much more healthy and are not so liable to disease. "Surai" which causes such loss in the Tanjore Delta as well as in other paddy growing districts is seldom seen in singly planted crops.
7. The plants ripen their grain better, and more evenly which means a heavier sample and not so much chaff.

Any one can adopt this practice without any difficulty and the following advice is given.

(1) If the seed is good and has been well dried and stored, 7 Madras measures can be sown in 7 cents of nursery. This will be ample to transplant one acre. Many ryots in Tanjore state that they only sow 3 Madras measures of *Sirmaui* and Red *Samba* to transplant one acre.

(2) If possible the cultivator should procure his seed from a crop which has been grown with single seedlings the year before. This is not essential for success, however, and after once raising a singly planted crop the cultivator can always save his own seed from it.

(3) The dry method of raising a nursery gives stronger seedlings than the wet nursery, *i.e.*, when the nursery has been ploughed in water.

(4) The seedlings should be transplanted before they become too old. They should not be left in the seed bed for more than one week for every month the crop has to grow, *i e.*, a five month variety should not remain in the seed bed for more than 35 days or five weeks.

(5) As regards the distance apart at which single seedlings should be transplanted the cultivator should use his own judgment. The following distances may, however, act as a guide. On land which produces over 1,000 Madras measures per acre, a span apart; on land which produces 750 Madras measures per acre, three-quarters of a span; and on land which produces 500 Madras measures per acre or less, half a span, will probably be the best distances. On very rich land which nominally produces 1,500 Madras measures per acre even as much as two spans apart between seedlings may give better results while on very poor land, *i.e.*, land which is always broadcasted though planting with single seedlings may give better results the seedlings will have to be so close that the cost of transplanting will be more than the additional value of the crop.

When a singly-planted crop is first transplanted it looks very thin, but this should not discourage the cultivator who tries this for the first time even though his neighbours predict that the crop will be a failure. When there is only one seedling present in the place of the 10 or 20 or even 30 which he usually transplants the newly planted crop must look comparatively thin, but it very soon fills out and presents a much better appearance than the crops of his neighbours planted in the ordinary way.

CULTIVATION OF CAMBODIA COTTON.

Cambodia cotton has now become a regular garden crop in Tinnevelly, replacing tobacco, ragi, chillies and other garden crops formerly grown. The reason for this is evident to any one who has grown the crop. Except for an occasional irrigation (about once or twice a month in the absence of rain according to whether the soil is deep or shallow) the cultivation expenses are the same as for an ordinary crop of cotton.

(2) On good well farmed and manured land such as garden lands always are, the yield of cotton is good 1,000 lb. to 1,250 lb. being given usually as the yield per acre by ryots who grow this cotton, though cases have been reported where the yield has been over 2,000 lb. of kappas per acre. The price paid by dealers for this cotton is usually R5 per pothie of 250 lb. more than the market rate. The reason for this higher rate is that the kappas gives a high proportion of lint, 1,500 lb. of kappas will give 500 lb. of lint, whereas about 2,000 lb. of the ordinary country cotton are required to give the same amount of lint. Moreover the mills of Tinnevelly District pay R5 per candy more for this cotton than for the country cotton.

(3) The method of cultivation is very simple, any well manured, well drained garden soil will yield well. The land should be well ploughed and at the ordinary season for sowing cotton, seed of this variety can be sown broadcast and covered with a light plough. Ten pounds of seed are quite sufficient for one acre. After sowing, the land should be laid out for irrigation. After the cotton crop is up and the plants have got their second leaves the field should be hand weeded and the surface loosened. When the plants are about a span high they should be thinned out to about 2 feet apart. If the land has been very well manured, they can be thinned out to 2½—3 feet apart. If not tinned, the plants will grow together, the branches will be thin and will not be able to support the weight of the bolls, which are very big. A second hoeing may be given before the plants completely cover the ground, after that they will give sufficient shade to

keep the weeds in check. Irrigation should be given if necessary only *i.e.*, if the crop is seen to need it. After the bolls have commenced to burst irrigation should not be given until the main picking is over, then the crop can again be watered to cause a second flush of leaves, flowers and bolls. Picking is very easy as the bolls are very large and open well and an experienced picker can easily pick from 100 to 125 lb. of clean kappas in a day.

This crop is specially recommended to ryots whose wells have not a sufficient supply of water to render grain crops certain.—*M. Mail*, April 11.

TACKINESS IN RUBBER.

A Bacteria Theory.

Mr. Hermann C T Gardner, in an article contributed to the *Financier*, states that the most reasonable explanation of the cause of tackiness as yet offered has been advanced by Bertrand, amongst others. This assigns the causation as due to decomposition of the peculiar albuminous matter associated with the crude product. The advocates of the decomposition theory suppose certain bactoria produce a putrefactive change in the protein, and that the products of putrefaction bring about changes in the neighbouring caoutchouc particles, which are communicable. After stating the theories he says:—

A careful survey of the theories, together with a consideration of the methods of production of those rubbers most liable to tackiness, points to a simple agent as the initial cause, to which the various agents cited may severally act as contributing causes, and hence may arise the diversity of opinion of different observers. This cause is nothing more than moisture. Spence presupposes the retention by the particular rubbers he experimented with of "absorbed" sulphuric acid. This acid has a powerful attraction for atmospheric moisture. This fact, in conjunction with the liability to tackiness of imperfectly dried or crudely-produced rubber, and reversely in the case of properly dried rubbers, is significant of the part played by interstitial moisture. Those planters who have adopted vacuum drying find their rubber for all practical purposes immune to tackiness. On the other hand, over-heated rubber rapidly becomes tacky in air. This may be due to partial oxidation ; it may also be due partly to the absorption of moisture on subsequent cooling. The practical outcome of theorising and experimentation is of more acute interest to the producer and to the manufacturer. An old proverb not inaptly remarks, " Prevention is better than cure," and prevention, so far as tackiness of rubber is concerned, merely consists in the production of a rubber as pure and as free from water as possible ; here I venture to suggest the assistance of the analyst is indispensable to the rubber buyer as a check, but more especially to the producer, as an indication of the value of the methods of production he employs.

The best means of production is adequately expressed as consisting in correct coagulation, correct pressing, correct drying, and at the end correct storing. A rubber, whose freedom from tackiness can be assured, is that coagulated by a reliable antiseptic process. Alcoholic creosote is suitable to the laboratory only ; mercuric chloride can be condemned on several counts ; common salt is unsatisfactory, and acetic acid is not a germicide, and, if not thoroughly removed from the rubber, rather aids than hinders tackiness. An ideally coagulated rubber should contain no protein, resin, mechanical or other impurity; and although these can be all removed yet, as far as resin is concerned, its removal is better suited to the laboratory than on the commercial scale. As regards pressing, some technicians advocate strong pressure, others light. I incline to the latter opinion, because over-compression of the rubber hinders the proper drying of the whole of the mass, unless it is in the form of crepe or thin biscuit or sheet. Passing to correct drying this may be taken as consisting essentially of gradual drying, because a show contraction gives a greater resiliency. Drying in vacuo is undoubtedly a means of retarding any tendency to tackiness.—*L. & C. Express*, March 11.

PRESERVING COPRA FROM MOULD.

In the October number of the *Tropical Agriculturist* particulars were given of experiments, conducted by M Dybowski, Director of the Paris Colonial Gardens, in the preservation of copra from mould by means of sulphurous acid. Samples treated in 1905, it was stated, still showed no signs of deterioration, and as the result of further experiments last June with coconuts from the Malay States it seemed to be proved that under the sterilising influence of the sulphurous gases the original condition of copra was maintained. At the request of a mercantile firm in Colombo we applied to M. Dybowski for further particulars and were informed that the process is based on the employment of the apparatus Marot, of which the Company, known as "Le Coprah," of Paris, is the proprietor. The special treatment is based on the sterilisation of the pulp of the coconut before dessication ; and this ensures perfect preservation and enables a copra, absolutely white and without a trace of rancidity, to be placed upon the continental markets. This is stated to give an added value estimated at five or six francs a hundred kilogrammes. The society does not sell its apparati, but is disposed to give licenses, under certain conditions, to Companies created for the purpose of exploiting the said processes.

THE BANANA

has become very popular in paris, and is sold freely in the streets. The increasing popularity of the fruit is amply justified, says a Paris contemporary, for Dr Max Makowsky in "Naturopath" gives the following analysis of tho fruit :—4·75 per cent of carburetted hydrogen, 19·50 per cent of alimentary salts, 1·75 per cent of cellulose, and 74 per cent of water. Tho doctor adds that all that is necessary for sustenance can be obtained from the banana and bread and butter.—*Indian Trade Journal*, April 7.

WILSON, SMITHETT & CO.'S CEYLON TEA MEMORANDA FOR 1909.

Summary of CEYLON TEA sold at Public Auction in London between January 1st and December 31st, 1909, estimated quantity in lbs. and average prices realised :—

Average Price for the Year was 8.15d per lb., against 7.80d in 1908 and 8d in 1907.

The initial letters following the estate names refer to the mean elevation, as follows :—
l (low) sea level up to 1,000 ft. hm (high medium) 2,500 to 3,500 ft, hh (highest) above 5,000 ft.
m (medium) 1,000 to 2,500 ft. h (high) 3,500 to 5,000 ft.

Over 750,000 lbs.

		1809 Abt. lbs.	Av. price per lb.	1908 Abt. lbs.	Av. price per lb.
Demodera	h	1,549,000	8⅞d	1,679,000	8¼d
Diyagama	h	1,227,500	9¾d	921,500	9⅛d
Mattakelly	h	876,000	8⅜d	668,000	8⅜d
Meddecombra (South)	h	615,000	8¼d	730,500	8d
Meddecombra (North)	h	305,000	8¾d	249,000	8d
Spring Valley	h	1,121,000	9d	1,138,000	8½d

500,000 lbs. to 750,000 lbs.

Badulla	h	552,500	8d	569,500	7¾d
Campden Hill	m	550,500	7⅞d	582,500	7½d
Cannavarella	h	625,000	8⅝d	575,500	8¼d
Craighead	m	552,000	7⅞d	504,500	7¾d
Delmar	h	507,500	9⅜d	467,500	9¼d
Drayton	h	526,000	8⅝d	493,500	8⅜d
Dunsinane	h	666,000	9d	617,500	9⅛d
Galaha	m	749,500	7d	736,000	6⅝d
Great Western	h	512,500	8⅝d	476,000	8⅝d
Gonakelle	hm	560,500	8½d	562,000	8d
Galatura	l	628,500	7⅛d	286,000	6⅞d
Hemingford	l	533,000	7d	476,000	6¾d
Hauteville	h	545,000	9¾d	573,000	9⅛d
Hapugastenne	m	637,500	7⅝d	251,000	7⅝d
IMP	m	581,500	8⅛d	523,000	7½d
Kurugama	l	538,500	7⅛d	536,500	7d
Le Vallon	hm	534,500	8⅛d	527,500	7⅝d
Mahadowa	h	563,000	8⅜d	497,000	7⅞d
Meeriabedde	h	541,500	8⅜d	496,500	8d
Poonagalla	hm	635,500	8¼d	382,000	8⅛d
St. Leonards	h	528,000	9¾d	658,500	9⅛d
Sunnycroft	l	619,000	7⅝d	767,500	7¼d
Talawakelle	h	546,500	9⅞d	483,500	9⅜d
Ury	m	536,000	8⅛d	320,000	7⅞d
Vellai-oya	h	643,000	7¾d	538,000	7⅝d
Waverley	h	508,000	10d	395,000	10d
Walpola	l	679,500	7d	551,500	6⅝d

350,000 lbs. to 500,000 lbs.

Antony Malle	h	368,000	7¼d	298,000	7⅛d
Abamalla	l	373,000	7⅛d	362,000	6⅞d
Bogawantalawa	h	373,000	9¼d	351,000	8⅝d
Bearwell	h	451,000	9⅛d	473,500	8¾d
Broadlands	l	363,000	7⅛d	287,500	6⅞d
Castlemilk	m	423,500	7¼d	365,000	7d
Clydesdale	h	376,000	9⅞d	325,000	9¼d
Cocogalla	hm	399,000	8⅛d	399,000	7⅞d
Chesterford	l	432,000	6⅞d	493,500	6⅞d
Degalessa	l	350,000	7⅛d	261,500	6⅞d
Digalla	l	411,000	7⅛d	378,000	7d
Elston	l	413,000	7¾d	421,000	7½d
Ernan	l	360,500	7d	270,500	6½d
Fordyce	h	361,500	8½d	366,500	7¾d
Gikiyanakanda	l	374,500	7½d	396,000	7¼d
Glen Alpin	h	387,000	8⅞d	392,500	8½d
Gallamudina	m	426,000	7¾d	404,500	7½d
Holyrood East	h	397,000	9⅞d	327,000	9⅞d
Hope	h	398,500	8⅝d	371,000	8⅜d
Halgolle	l	368,000	7½d	298,500	7⅛d

350,000 lbs. to 500,000 lbs.

		1909 Abt. lbs.	Av. price per lb.	1908 Abt. lbs.	Av. price per lb.
Kellicbedde	h	400,000	9d	388,000	8½d
Kirkoswald	h	398,000	9⅛d	381,000	8¼d
Laxapana	h	368,000	8⅜d	335,500	7⅞d
Ledgerwatte	h	427,500	8¾d	450,000	8¼d
Lavant	l	353,000	6¾d	329,000	6⅜d
Loolecondera	h	396,500	8d	445,000	7½d
Maddegedera	l	358,500	7⅛d	57,500	6⅞d
Mayfield	h	392,000	8¼d	374,000	8d
Mooloya	h	457,000	9¾d	443,500	9⅛d
Muendeniya	hm	484,000	7d	471,000	7d
Nilambe	hm	401,000	7⅜d	310,500	7⅛d
Needwood	h	478,500	8⅝d	457,000	8¼d
North Matale	m	378,000	7d	148,000	7⅛d
Norwood	h	417,500	8⅝d	394,500	8d
New Peradeniya	hm	466,000	7¼d	411,500	6¾d
Ouvahkellie	h	362,000	9⅜d	344,000	9¼d
Panawatte	l	469,000	7⅛d	356,000	6½d
Penrith	l	469,500	7¼d	472,000	7d
Pita Ratmalie	h	368,500	9d	323,000	8⅞d
Pussetenne	m	438,500	7¼d	376,500	6⅞d
Ragalla	h	493,500	9⅝d	513,500	9d
Rangalla	hm	470,000	7⅜d	393,500	7⅜d
Rangbodde	h	491,500	8⅛d	485,500	7⅝d
Rothschild	h	376,000	8d	387,500	7¾d
Sandringham	h	429,500	9⅜d	333,000	9⅜d
Sheen	h	387,000	9d	347,500	8¾d
Swinton	hm	365,000	7⅜d	132,500	7½d
Tangakelly	h	401,500	8⅞d	462,000	8⅝d
Tillicoultry	h	474,000	10¼d	461,500	10¼d
Tyspane	h	370,000	7⅝d	358,500	7¼d
Udaradella	hh	378,000	10⅞d	381,500	9¾d
Ukuwella	m	403,500	7⅛d	403,500	6⅞d
Warriagalla	m	388,500	7⅝d	346,000	7⅛d
Wattagodde	h	415,500	8⅞d	401,500	8½d
Woodend	l	410,000	7d	374,000	6¾d

200,000 ibs. to 350,000 lbs.

Abbotsford	hh	215,000	8⅜d	109,000	8d
Adam's Peak	h	231,500	8⅛d	229,500	7⅝d
Attabagie	m	240,000	7⅝d	197,000	7⅜d
Allakolla	hm	209,000	7⅛d	192,000	6¾d
Aldie	h	222,000	9⅝d	223,000	9d
Alnwick	h	227,000	9d	199,500	8⅝d
Ambatenne	l	233,500	7⅛d	224,500	6⅝d
Ampitiakande	h	226,000	7¾d	155,500	7½d
Annfield	h	243,000	9d	201,000	8¾d
Ardross	l	204,000	6⅞d	137,000	6¾d
Atherfield	l	201,000	7d	177,000	6¾d
Atgalla	m	274,000	7¾d	207,500	7½d
Ambanpitiya	l	238,500	7¾d	209,500	7⅜d
Beaumont	m	330,500	7⅜d	307,000	7⅛d
Binoya	hm	243,000	7⅝d	190,500	7¼d
Blackstone	h	308,500	7d	342,500	6⅞d
Bogahawatte	h	211,500	8⅛d	185,000	7⅝d
Bogawana	h	202,500	9⅛d	182,000	8⅝d
Brae	hm	330,500	7d	344,500	6⅞d
Burnside Group	m	301,500	7⅛d	89,500	7¼d

200,000 lbs. to 350,000 lbs.

		1909 Abt. lbs.	Av. price per lb.	1908 Abt. lbs.	Av. price per lb.
Bridwell	h	200,000	9⅛d	193,000	8¾d
Blackwater	m	268,000	7⅜d	288,000	7d
Bambrakelly	h	260,000	8⅛d	—	—
Calsay	h	239,000	9⅞d	215,500	9⅛d
Campion	h	334,000	9⅝d	333,500	9½d
Cattaratenne	hm	229,500	6⅞d	159,500	6⅞d
Chapelton	h	266,000	9⅞d	259,500	9⅛d
Craigie Lea	h	333,000	8½d	325,000	8d
Cranley	h	263,000	10½d	229,000	10⅜d
Culloden	l	246,500	6⅞d	65,500	6⅞d
Cullen	m	337,000	8¼d	280,500	7⅞d
Dartry	m	310,000	7⅛d	322,000	7⅛d
Debatgama	m	252,000	7⅜d	243,500	6⅞d
Deeside	h	200,000	8¾d	182,000	8¼d
Delta	h	209,000	8⅜d	199,000	7½d
Dessford	h	291,000	8¾d	271,500	8½d
Deviturai	hm	266,000	7¼d	75,000	7¾d
Duckwari	hm	229,000	7⅞d	249,500	7⅝d
Doragalla	hm	284,000	7⅝d	234,000	7⅜d
Darrawella	h	252,000	8⅝d	225,500	8¼d
Ederapolla	l	287,000	7⅛d	305,500	7d
Eildon Hall	h	250,500	9¼d	81,000	9⅜d
Elbedde	h	335,500	8⅝d	304,500	8¼d
Elkadua	hm	241,000	8d	305,000	6⅞d
El Teb	m	322,500	9d	279,500	9d
Farm	m	251,500	7¾d	237,000	7½d
Gallebodde	m	208,000	8¾d	211,500	8½d
Glenugie	h	222,000	9½d	205,000	8¾d
Glenlyon	h	284,500	9⅜d	314,000	9d
Goorookoya	m	339,000	7¾d	345,500	7¼d
Gouravilla	h	321,500	8¾d	277,500	8¼d
Goonambil	hm	310,000	7¼d	242,000	7⅛d
Gordon	h	304,500	8⅞d	299,500	8¾d
Gowerakelle	m	318,000	8⅜d	290,500	8⅛d
Galphele	m	340,500	7¼d	227,500	7¾d
Hanipha	h	281,000	7⅞d	46,500	8⅛d
Henfold	h	227,000	10⅞d	214,000	10½d
Hindagalla	m	242,000	9¼d	267,000	8¾d
Hoonoocotua	h	289,000	7⅜d	282,500	7⅛d
Holyrood West	h	204,500	9¾d	191,500	9⅞d
Hunasgeria	hm	224,000	7⅛d	206,000	6⅞d
Hopewell	hm	264,500	7⅝d	157,000	7¼d
Hayes	m	254,500	7⅛d	250,500	6¾d
Indurana	l	203,500	7¼d	175,000	7d
Ingurugalla	m	226,000	7⅜d	222,500	7⅛d
Imboolpittia	m	219,000	8½d	239,500	8⅛d
Kabragalla	h	216,500	7¾d	152,000	7⅝d
Kadien Lena	m	248,500	7⅞d	301,500	7⅜d
Kataboola	h	340,500	8⅜d	289,000	7⅞d
K.A.W.	hm	229,000	7⅜d	96,500	6½d
Kehelwatte	m	282,500	7⅞d	130,500	7⅞d
Kelburne	h	248,000	8⅛d	300,000	7¾d
Knuckles Group	hm	271,500	7⅞d	297,500	7⅝d
Kotiyagalla	h	327,000	10¼d	347,000	9½d
Kuda Oya	h	259,000	7⅝d	215,000	7⅝d
Kahagalla	h	240,000	9d	224,000	8⅝d
Kenmare	h	220,500	9⅝d	—	—
Labukelle	h	340,000	8⅝d	298,500	8¼d
Lippakelle	h	257,500	9⅜d	284,000	8⅞d
Leangawella	hm	242,000	8⅜d	206,500	7⅝d
Lebanon Group	hm	243,000	7½d	187,000	7¼d
Malvorn	h	267,000	7½d	239,500	7⅛d
Mahausa	m	269,000	7⅜d	259,000	7⅛d
Maha Oya	hm	263,000	7⅛d	294,500	7d
Mariawatto	h	322,500	7⅝d	260,500	7½d
Melfort	hm	211,000	8⅛d	177,500	8d

200,000 lbs. to 350,000 lbs.

		1909 Abt. lbs.	Av. price per lb.	1908 Abt. lbs.	Av. price per lb.
Morar	h	221,500	8¼d	194,500	7¾d
Mount Vernon	h	222,500	10d	135,500	10⅝d
Meddakande	m	332,500	7¾d	147,000	7⅝d
Nilloomally	h	202,500	7½d	189,500	7¼d
New Rasagalla	hm	207,500	8⅛d	84,000	7¾d
Nikakotua	l	262,500	7⅜d	21,000	7⅜d
Nayabedde	h	270,000	9⅜d	265,500	8¾d
Nayapane	hm	205,500	8d	179,000	7⅜d
New Peacock	h	282,000	8⅜d	278,000	8⅛d
Nicholaoya	hm	238,500	7⅛d	296,000	7d
North Pundaloya	h	244,000	8⅛d	59,000	8¼d
Pambagama	l	320,000	7⅛d	417,000	6¾d
Parragalla	hm	284,500	8⅛d	270,000	7¾d
Pen-y-lan	m	201,500	7⅜d	225,500	7d
Pingarawe	hm	230,500	8½d	170,500	8⅝d
Portmore	h	262,500	10⅛d	271,500	9⅞d
Pundaloya	h	254,000	9d	264,000	8⅞d
Parkfield	...	239,500	7⅜d	215,000	6⅞d
Pine Hill	m	213,500	8d	193,500	7½d
Queensberry	h	279,500	8½d	318,000	8½d
Rugby	m	256,000	7⅜d	228,500	7⅛d
Radella	h	251,000	9¾d	225,500	9d
Rappahannock	h	200,500	8½d	167,000	8¼d
Raxawa	m	266,500	8d	235,000	7⅝d
Rosita	h	342,500	9d	283,500	8⅞d
Rutland	h	298,500	7¾d	293,000	7⅜d
Sanquhar	hm	215,000	7¾d	73,000	7¾d
Sarnia	m	300,500	8¼d	283,000	8d
St. Andrew's (Maskeliya)	h	238,000	8d	219,500	7½d
St. John del Rey	h	319,000	8⅝d	348,000	8d
Sinnapitia	m	207,000	7⅝d	185,000	7¼d
Sogama	hm	299,500	7¾d	240,000	7⅜d
Springwood	m	204,000	7 d	209,000	6⅝d
Stockholm	h	210,000	7⅞d	161,500	7⅞d
Stonycliff	h	250,500	9⅜d	228,500	8⅜d
Sorana	l	233,000	7¼d	296,000	6¾d
Sapumalkande	l	224,500	6⅝d	251,000	6½d
Strathisla	m	212,500	7⅛d	218,000	6¾d
Syston	m	273,000	7⅞d	169,500	7¾d
Tallagalla	l	233,500	7⅝d	267,000	7¼d
Thornfield	h	329,000	9⅜d	270,000	9d
Tillyrie	h	245,000	9d	245,500	8⅝d
Telbedde	hm	282,500	9d	266,500	8⅝d
Tamilagolla	l	312,500	7d	329,000	6¾d
Tamaravelly	m	214,500	7⅜d	—	—
Verulupitiya	l	214,500	7⅛d	226,500	6⅞d
Waldemar	h	202,500	8⅝d	172,000	8⅞d
Wangie Oya	h	202,000	8⅞d	210,000	8¼d
Wewesse	hm	226,500	8¼d	216,000	7¾d
Wihiragalla	h	342,500	8⅜d	330,000	7¾d
Windsor Forest	h	209,500	6¾d	210,000	6⅝d
Westhall	hm	337,000	7⅝d	367,000	7⅛d
Ythanside	h	272,000	8½d	221,000	8½d
Yogama	l	319,500	7⅛d	283,500	6½d

100,000 lbs. to 200,000 lbs.

Agrakande	h	170,000	9¼d	123,000	8¾d
Albion	h	151,500	9⅝d	108,500	9⅛d
Allagalla	m	147,000	7⅛d	123,000	7d
Alton	h	141,500	8⅜d	107,500	8d
Amherst	h	156,500	8⅞d	263,000	8¼d
Ambawella	h	110,500	9¼d	98,500	8½d
Arslena	hm	149,000	7⅜d	125,500	6⅝d
Asgoria	m	141,000	7⅜d	120,500	7¼d
Augusta	hm	120,000	7⅛d	111,500	6¾d

100,000 lbs. to 200,000 lbs.

		1909 Abt. lbs.	Av. price per lb.	1908 Abt. lbs.	Av. price per lb.
Avoca	h	105,500	9d	80,500	8⅜d
Appachy Totam	h	145,000	9½d	115,000	9d
Barnagalla	m	184,000	7⅝d	190,000	7½d
Bellwood	hm	119,500	3⅜d	116,500	7½d
Berragalla	h	143,000	8½d	178,000	8⅛d
Brookside	hh	136,000	10½d	136,500	10⅛d
Broughton	h	186,000	8¼d	185,000	7¾d
Braemore	h	194,000	8¾d	177,500	7⅞d
Beddegama	hm	182,500	7⅝d	152,500	7⅜d
Balado	...	186,500	7¼d	136,000	7d
Cairn-mon-earn	hm	100,000	7¼d	95,500	7¼d
Caledonia	h	135,000	10⅝d	127,000	10⅜d
Clontarf	l	102,000	7¼d	94,500	6⅞d
Condegalle	h	194,500	8½d	178,500	8d
Coolbawn	m	100,500	7⅞d	101,500	7½d
Cottaganga	h	152,000	7⅞d	156,500	7¼d
Craig	hm	173,500	9d	163,000	8⅜d
Clodagh	hm	161,500	7½d	103,500	7⅛d
Dea Ella	m	120,500	6⅝d	44.500	6⅜d
Deanstone	h	147,500	7⅞d	75,500	7½d
Dehiowita	m	114,000	6⅞d	121,000	6⅜d
Deltotte	hm	190,500	7½d	184,500	7⅛d
Denegama	h	137,000	7½d	132,000	7¼d
Densworth	l	145,500	7d	146,500	6½d
Derryclare	h	164,500	8¾d	140,000	8½d
Dimbula	h	191,000	9d	128,000	9d
Diyanilakelle	h	114,500	10½d	111,500	10⅞d
Doombagas-talawa	h	143,500	8d	174,500	7⅛d
Doteloya	m	183,000	7⅜d	200,500	6⅝d
Dromoland	m	135,500	6⅝d	91,500	5⅞d
Eallawattie	m	130,000	9⅜d	126,500	9⅜d
Ellagalla	m	158,500	7¼d	159,500	7d
Eltofts	h	139,000	9½d	141,500	8¾d
Emelina	h	117,500	8⅜d	107,000	7⅞d
Ellamulle	hh	128,000	8⅜d	153,500	8d
Edward Hill	h	115,000	7¼d	39,500	6¼d
Eaglesland	l	134,000	7⅛d	—	—
Eskdale	h	117,000	9⅝d	—	—
Fairfield	h	178,500	8⅞d	151,000	8½d
Fernlands	h	148,500	8¾d	189,500	9d
Forres	h	165,500	8⅞d	168,500	8½d
Ferham	h	157,000	9⅜d	151,500	9⅜d
Galkadua	l	159,000	7d	289,500	6¾d
Glenalla	l	105,000	6⅝d	—	—
Galkandewatte	h	134,000	9⅛d	157,500	8⅞d
Gammadua	h	157,500	6⅞d	150,000	6¾d
Gangwarily	m	148,500	7d	—	—
Gartmore	h	186,000	8¾d	155,500	8½d
Glenloch	m	195,000	7¾d	122,000	7¾d
Goatfell	h	106,500	10¾d	47,500	11⅛d
Gonamatava	h	174,000	8¾d	140,500	8¾d
Gorthie	h	162,500	8¾d	136,500	8⅜d
Glendevon	h	182,500	9⅛d	36,000	9⅞d
Halwatura	l	178,000	7d	145,000	6¼d
Hapugahalande	m	157,000	7⅛d	—	—
Hatale	h	166,000	7½d	148,000	7d
Holmwood	h	190,000	9⅝d	168,000	9¼d
Havilland	m	145,000	7d	—	—
Hoolankande	l	170,000	7⅜d	160,000	7d
Hingurugama	hm	170,500	7⅞d	222,500	7¾d
Handford	m	106,500	7⅝d	84,500	7¼d
Ingoya	m	195,500	7⅛d	225,000	7d
Iona	h	136,500	9¼d	122,500	9⅜d
Kaipoogalla	h	123,500	9⅝d	113,000	9d
Kaloogalla	m	171,000	7⅝d	136,000	7⅛d
Kallebokka	h	138,500	7½d	86,500	7½d

100,000 lbs. to 200,000 lbs.

		1909 Abt. lbs.	Av. price per lb.	1908 Abt. lbs.	Av. price per lb.
Kalupahani	h	163,500	8⅛d	164,500	7⅝d
Kandanewera	hm	151,500	7⅞d	223,000	7⅛d
Keenakelle	l	199,500	7¼d	246,500	7⅛d
Kintyre	h	152,000	8⅝d	147,000	8d
Kirrimittia	m	198,500	7½d	212,000	7⅛d
Kowlahena	h	161,500	9⅛d	146,000	8⅝d
Kottagalla	h	104,000	8⅞d	77,000	7½d
Kew	hh	164,000	8½d	171,000	8d
Katooloya	h	199,000	8d	240,500	7⅞d
Karandupona	l	189,500	7¼d	170,500	6¾d
Kildrochet	m	142,000	7⅜d	137,000	7d
Lugaloya	...	176,500	7⅜d	198,000	7¼d
Lauderdale	hm	122,500	7⅜d	133,500	7⅛d
Lawrence	h	188,000	8⅜d	213,500	7⅞d
Lindoola	h	173,500	9¼d	163,000	9¼d
Luccombe	hm	126,000	7¾d	—	—
Lynford	h	142,500	9d	118,500	8⅜d
Macduff	h	147,500	9⅛d	121,000	8⅞d
Mahacoodagalla	h	144,500	9⅛d	166,000	8⅛d
Meria Cotta	h	153,500	9⅝d	118,500	9¼d
Midlands	hm	156,000	7⅜d	152,500	7¼d
Mipitiakande	l	155,000	7½d	163,000	7¼d
Moolgama	m	114,000	7⅜d	128,500	7¼d
Moralioya	l	130,500	7d	136,500	6⅝d
Mount Pleasant	hm	120,500	7⅝d	110,000	7⅜d
Mudumana	l	134,000	7⅜d	174,500	7d
Meddetenne	m	154,500	7½d	94,000	7¼d
Mahagastotte	h	194,000	9¼d	167,000	8⅜d
Maha Eliya	h	132,500	9d	54,000	7½d
Morankande	m	124,000	6⅞d	134,000	6⅝d
New Forest	h	164,500	7¾d	149,000	7¾d
Newton	h	142,000	8¼d	129,000	8d
Oolapane	m	119,000	7⅜d	95.000	7⅛d
Osborne	h	106,500	8⅛d	114,500	8⅛d
Overton	h	151,000	9d	145,000	8¾d
Peradenia	h	183,500	7½d	171,500	7¼d
Portree	h	131,000	7⅞d	135,000	7½d
Poengalla	m	154,500	7⅜d	155,000	7⅛d
Palangie	h	160,000	8⅝d	101,000	8¼d
Relugas	hm	154,500	7½d	159,500	7d
Riverside	m	147,500	6⅞d	138,500	6⅝d
Rillamulle	h	119,000	9d	115,500	8¾d
Ritnageria	h	107,500	9½d	110,500	9⅜d
Rookatenne	h	142,500	8d	72,500	8⅝d
Roehampton	hm	118,000	8⅜d	115,500	7¾d
Sirisanda	l	148,500	7⅛d	130,000	7d
Stinsford	l	130,000	7d	120,500	6⅞d
St. Andrew's (Dimbula)	h	106,500	9⅝d	92,500	9⅜d
Scarborough	h	107,000	8⅝d	97,500	7⅞d
Silver Kandy	hh	110,000	9⅞d	135,500	9⅛d
Somerset	h	189,000	9¼d	132,500	8⅞d
South WanaRajah	h	132,000	7½d	162,000	7⅜d
Stellenberg	h	155,500	9¼d	169,500	8¾d
Sutton	h	135,500	10⅞d	124,500	10⅝d
Sumtravalle	h	151,000	9⅜d	130,500	8¼d
Taurus	h	123,000	9¼d	105,500	8¾d
Thotulagalla	h	156,500	8⅞d	154,000	8⅜d
Troup	h	140,000	9⅜d	173,000	8⅝d
Taldua	l	149,500	6⅞d	41,500	6¼d
Ulatenne	...	104,000	7¾d	82,000	7½d
Udaveria	hh	173,500	9⅛d	175,500	8⅝d
Upper Haloya	hm	158,000	7⅝d	93,500	7⅜d
Unugalla	hm	114,500	7⅜d	66,500	7⅜d
Venture	h	179,500	8¼d	163,500	7¾d
Welkandala	l	197,000	7⅜d	239,000	7⅛d
Wavena	hm	190,500	7⅛d	102,500	7⅛d

100,000 lbs. to 200,000 lbs.

		1909 Abt. lbs.	Av. price per lb.	1908 Abt. lbs.	Av. price per lb.
Wallaha	h	147,000	9½d	124,500	9⅜d
Waltrim	h	136,000	9¾d	136,000	9⅝d
Warwick	h	187,000	9d	189,500	8¾d
Wattakelly	h	154,500	7⅜d	165,500	7⅛d
West Haputale	h	117,000	8⅝d	111,500	8⅛d
Wereagalla	l	183,000	7¼d	52,500	7⅜d
Wewelmadde	m	137,000	7¼d	114,500	7⅛d
Wevekellie	m	163,500	7¼d	138,500	7d
Weyweltalawa	m	148,000	7½d	143,000	7¼d
Wigton	h	187,000	7⅝d	158,500	7¼d
Wootton	h	177,000	8¾d	164,000	8⅜d
Yapame	hm	169,000	8d	137,500	7¾d
Yoxford	h	147,000	9d	150,000	8½d

50,000 lbs. to 100,000 lbs.

		1909 Abt. lbs.	Av. price per lb.	1908 Abt. lbs.	Av. price per lb.
Bathford	h	87,000	8⅞d	89,000	8⅜d
Batgodde	h	89,500	8d	95,000	7⅝d
Battalgalla	h	70,500	10⅝d	67,000	9⅞d
Berat	h	98,000	8¾d	97,500	8⅛d
Beaconsfield	h	67,500	8¼d	63,500	7¾d
Blackburn	m	83,000	6⅜d	94,000	6⅛d
Blair Athol	h	87,000	7¾d	94,000	7⅜d
Blair Avon	h	55,000	7⅞d	—	—
Bon Accord	h	75,500	8⅞d	76,500	7¾d
Belton	h	76,500	7¾d	70,000	7¾d
Carlabeck	h	87,000	9½d	93,500	8¾d
C'Galla	m	91,000	7½d	84,000	7½d
Dangkande	hm	99,000	7¾d	90,500	7⅜d
Delpotonoya	h	81,000	7¼d	72,500	7d
Deyanella	hm	98,000	7⅞d	94,000	7¼d
Donside	hm	94,000	7⅛d	123,500	6⅞d
Devon	h	94,500	9d	103,000	8¼d
Denmark	hm	58,000	7d	53,000	6¾d
Dotala	h	82,000	8⅛d	20,500	8⅛d
Eladuwa	l	62,500	7⅛d	69,000	6⅝d
Fetteresso	hh	84,000	8¾d	80,000	8d
Fruit Hill	h	78,000	7¾d	89,000	7¼d
Forest Hill	hm	78,500	6¾d	76,500	6¾d
Galoola	h	79,000	8d	35,500	8¼d
Gunville	h	88,500	8¾d	—	—
Galgawatte	m	60,500	7¼d	83,500	7d
Ganapalla	l	64,500	7⅛d	59,500	7⅛d
Glenorchy	h	78,500	8¾d	40,500	8½d
Gonavy	h	87,500	7⅞d	15,000	8⅞d
Holbrook	h	76,500	9⅝d	86,500	9⅝d
Hunugalla	h	73,000	6⅝d	63,500	6⅛d
Hyndford	m	68,000	7¾d	—	—
Harmony	m	60,500	7⅞d	59,000	7⅜d
Ivies	l	90,000	6⅝d	112,500	6½d
Indian Walk	l	68,000	6½d	67,000	6⅜d
Kelvin	m	90,500	7¾d	96,000	7¼d
Kalupane	m	74,500	7⅜d	101,500	7d
Lynsted	h	56,500	8¼d	107,000	8⅛d
Lochnagar	m	97,500	7½d	—	—

50,000 lbs. to 100,000 lbs.

		1909 Abt. lbs.	Av. price per lb.	1908 Abt. lbs.	Av. price per lb.
Monaragalla	m	98,500	7¼d	102,000	6⅞d
Maryland	hm	52,500	6¾d	45,000	6¾
Marakona	m	71,000	7¼d	68,500	7dd
Mandara Newera	h	60,000	8¾d	73,000	7⅝d
Midlothian	h	62,500	8¼d	—	—
Napier	h	88,000	8¼d	65,000	8¼d
Narangalla	h	83,500	6¾d	94,500	6⅝d
Norton	hm	97,000	7½d	57,000	7⅛d
Nutbourne	h	99,000	9¾d	82,500	10d
Nahaveena	hm	50,000	7¼d	51,500	7d
Pati Rajah	m	94,000	6¾d	95,500	6¾d
Peacock Hill	hm	70 000	7¼d	64,500	6⅞d
Rickarton	hm	91,000	8⅛d	82,000	7½d
St. Helens	m	91,500	6⅞d	90,500	7d
St. Leys	h	60,000	7¾d	52,500	7¼d
Strathdon	hm	74,500	7⅜d	36,000	7d
Shannon	hm	55,500	7⅝d	97,500	7⅜d
Summerville	h	90,000	7⅞d	66,500	7¾d
St. Coombs	h	93,500	8⅞d	88,500	8⅝d
Tebuwana	h	55,500	6⅞d	60,000	6½d
Tientsin	h	69,000	10d	66,000	9⅛d
Weymouth	l	76,500	7½d	84,500	7d
West Fassifern	h	66,500	10¼d	68,500	10⅜d
Wattawella	m	94,500	7½d	95,500	7⅛d
Wewebedde	h	97,500	7¾d	101,500	7⅝d
Yuillefield	h	62,500	8⅞d	59,500	8⅜d

20,000 lbs. to 50,000 lbs.

		1909 Abt. lbs.	Av. price per lb.	1908 Abt. lbs.	Av. price per lb.
Abergeldie	hm	34,000	7⅜d	26,000	7⅜d
Amblamana	m	31,000	7d	41,000	7⅛d
Beverley	l	29,500	6⅞d	62,500	6¾d
Coodoogalla	m	38,000	6⅞d	29,500	6⅞d
Choughleigh	hm	44,500	7¾d	47,000	7⅜d
Craigengilt	m	22,500	7⅜d	—	—
Elfindale	h	45,000	7d	150,000	7⅛d
Ferndale	h	31,500	6¾d	130,500	7d
Glencairn	h	32,000	8¼d	86,500	7⅜d
Glanrhos	l	39,500	7d	185,500	6½d
Gonagalla	...	34,500	8⅛d	—	—
Heatherton	hm	32,000	7¼d	—	—
Invery	h	33,000	8¼d	99,500	7¾d
Kumaradola	m	23,000	7⅜d	26,000	6⅞d
Karagastalawa	h	36,000	6⅞d	54,000	6¾d
Loinorn	h	25,000	9⅝d	116,500	8¾d
Lonach	hm	32,000	7d	29,000	6¾d
Mottingham	h	36,500	8⅛d	—	—
Mousa Kande	m	28,000	6¼d	—	—
Pondappe	hm	32,000	6¾d	59,500	6⅝d
Rajawella	l	42,500	7d	35,000	6⅞d
Ridgmount	...	20,500	7d	37,500	6d
Shamrock	m	22,000	7⅝d	—	—
Warriapolla	m	43,500	7⅝d	48,000	7⅛d
Weemalle	m	31,500	7d	31,500	6⅝d

Estimated relative Yield and Average Price realised for the different Ceylon Tea Districts, compiled from the Public Auctions held in London between January 1st and December 31st, 1909:—

	lbs. about 1909.	Av. Price per lb. about. 1909.	lbs. about 1908.	Av. Price per lb. about. 1908.	lbs. about 1907.	Av. Price per lb. about 1907.
Uda-Pussellawa	3,272,000	9·35d	3,135,000	9.00d	2,820,000	8·95d
Dimbula	20,623,000	9·23	18,128,000	8·90	18,588,000	8·76
Dikoya	4,600,000	8·95	4,908,000	8·50	6,017,000	8·45
Bogawantalawa	2,904,000	8·75	2,978,000	8·20	3,446,000	8·45
Nuwara Eliya and Maturata	1,997,000	8·50	2,198,000	7·70	2,133,000	8·30
Haputale and New Galway	5,982,000	8·50	5,384,000	8·20	5,260,000	8·10
Uva	10,962,000	8·35	9,549,000	8·10	10,057,000	8·10
Maskeliya	3,718,000	8·25	2,885,000	7·90	3,078,000	8·05
Hewaheta	2,210,000	8·25	2,163,000	7·80	2,127,000	8·05
Pussellawa, Kotmale, Pundaluoya and Ramboda ...	10,867,000	8·05	10,101,000	7·75	9,744,000	7·85
Ambegamuwa and Lower Dikoya	3,246,000	7·60	2,789,000	7·35	2,972,000	7·65
Dolosbage and Yakdessa ...	3,961,000	7·45	3,582,000	7·20	3,195,000	7·55
Knuckles, Kallebokka and Rangala	4,870,000	7·55	4,247,000	7·35	4,044,000	7·60
Nilambe and Hantane ...	3,855,000	7·45	3,502,000	7·10	3,976,000	7·40
Matale and Hunasgeria ...	6,121,000	7·30	4,636,000	7·05	5,647,000	7·30
Sabaragamuwa	2,051,000	7·55	2,033,000	7·15	1,486,000	7·50
Kelani Valley and Kegalla	11,568,000	7·15	10,854,000	6·85	9,210,000	7·30
Kadugannawa, Alagalla and Kurunegala	2,284,000	7·40	2,353,000	7·10	2,397,000	7·45
Kalutara, Ambalangoda and Udugama	2,280,000	7·20	1,896,000	6·80	2,031,000	7·20

Weekly Public Auctions of Ceylon Tea during **1909** with average price realised:—

Week ending.	Number of Packages offered in auction.	Av. price per lb.	Av. price per lb. for corresponding week 1908.	Week ending.	Number of Packages offered in auction.	Av. Price per lb.	Av. price per lb. for corresponding week 1908.
Jan. 9th	37,700	8·20	8·35	July 3rd	41,115	7·75	7·40
" 16th	29,890	8·15	8·20	" 10th	30,000	7·70	7·35
" 23rd	24,860	8·05	8·20	" 17th	28,070	7·80	7·40
" 30th	27,260	7·80	8·10	" 24th	32,800	7·75	7·50
Feb. 6th	19,877	8·10	8·05	" 31st	43,129	7·75	7·45
" 13th	23,337	8·25	8·00	Aug. 7th	no sales	—	—
" 20th	23,775	8·55	7·80	" 14th	40,644	7·85	7·30
" 27th	19,980	8·70	7·65	" 21st	33,100	8·00	7·40
March 6th	29,960	8·45	7·60	" 28th	35,270	8·15	7·65
" 13th	22,440	8·60	7·65	Sept. 4th	28,950	8·25	7·75
" 20th	18,800	8·45	7·65	" 11th	22,600	8·40	7·85
" 27th	25,488	8·40	7·80	" 18th	21,380	8·55	7·95
April 3rd	19,000	8·50	7·80	" 25th	25,327	8·60	8·00
" 10th	28,843	8·60	7·80	Oct. 2nd	19,000	8·60	7·85
" 17th	no sales	—	7·95	" 9th	20,450	8·65	7·80
" 24th	33,437	8·40	—	" 16th	16,166	8·40	7·80
May 1st	23,360	8·45	7·90	" 23rd	20,000	8·40	8·13
" 8th	31,420	8·25	8·00	" 30th	16,830	8·40	8·00
" 15th	29,640	8·15	8·10	Nov. 6th	23,000	8·40	8·30
" 22nd	31,625	7·95	7·95	" 13th	14,550	8·25	8·20
" 29th	28,560	7 90	7·90	" 20th	22,270	8·30	8·35
June 5th	no sales	—	7·75	" 27th	17,775	8·55	8·40
" 12th	46,400	7·70	—	Dec. 4th	21,670	8·50	8·40
" 19th	37,300	7·75	7·55	" 11th	19,600	8·70	8·55
" 26th	37,500	7·75	7·40	" 18th	26,900	8·50	8·55
				" 25th	21,000	8·40	no sales